IMPERIAL MYCOLOGICAL INSTITUTE

REVIEW
OF
APPLIED MYCOLOGY

VOL. XXI AUGUST 1942

YOUNG (P. A.). **Varietal resistance to blossom-end rot in Tomatoes.**—*Phytopathology*, xxxii, 3, pp. 214–220, 1 fig., 1942.

The following tomato varieties were the most resistant to blossom-end rot [*R.A.M.*, xix, p. 169] in trials at the Texas Agricultural Experiment Station from 1937 to 1939: Blair Forcing, Break o' Day, Grothen's Red Globe, Long Calyx Forcing, Marglobe, Marhio, Marvana, Marvel, Michigan State, Newport, Pritchard, Surest Forcing, and the white-flowered selections from X-ray-treated seed (*J. Hered.*, xxxi, pp. 78–79, 1940). Riverside, Louisiana Red, and Buckeye State were highly susceptible, and a number of others intermediate in their response. In tests carried out in 1940 the disease was shown to bring about a reduction in yield, which was not, however, closely correlated with the number of affected fruits per plant, but seemed to depend on the differential fruit-setting capacities of individual varieties. There was no apparent connexion between the incidence of wilt (*Fusarium* [*bulbigenum* var.] *lycopersici*) or differences in the copper spray programme [*R.A.M.*, xvi, p. 420] and reaction to blossom-end rot among the varieties tested. In addition to the usual features of the disorder, including extensive sunken, brown, well-defined, necrotic lesions in the peel of the blossom-end and flattening of the fruits, an uneven surface, with the formation of brown areas, indicating disorganization of the underlying tissues, developed in the course of a rainy spell in June, 1940, mostly on the Buckeye State variety.

BARRATT (R. W.). **Occurrence of Tomato leaf mold and of Muskmelon powdery mildew in the field in New Hampshire.**—*Plant Dis. Reptr*, xxvi, 2, p. 49, 1942. [Mimeographed.]

Rapid spread of tomato leaf mould (*Cladosporium fulvum*) was observed between 8th August and 1st September, 1941, in the field at the Durham (New Hampshire) Horticulture Farm, to which the pathogen is believed to have been carried on greenhouse-raised seedlings. Complaints regarding the disease were likewise received from home gardens procuring their plants from the same source. Muskmelons at the Farm were severely attacked by *Erysiphe cichoracearum*, which is also thought to have originated in the greenhouse.

BLOOD (H. L.). **Control of bacterial canker of Tomatoes.**—*Canning Age*, xxiii, 4, pp. 221–223, 2 figs., 1942.

The writer describes the symptoms of tomato bacterial canker (*Phytomonas michiganensis*) [*Corynebacterium michiganense*] and gives the following recommendations for its control, based on work conducted at the Utah Agricultural Experiment Station [*R.A.M.*, xiii, p. 478; xiv, p. 681]. Extract seed by thorough fermentation of macerated pulp for 96 hours at or below 70° F., stirring twice daily to keep the pomace submerged; treat extracted seed immediately by 24 hours' immersion in 0·8 per cent. acetic acid (0·6 per cent. for dried seed); use a clean seed-bed, all soil of sites on which

the disease has occurred being replaced to a depth of 10 to 12 in. by new soil after drenching the subsoil with 1 in 24 formaldehyde, which may also be used for washing all frames, sash, and covers; practise a minimum rotation of three years; and rogue out all diseased plants before harvest.

HORSFALL (J. G.) & HEUBERGER (J. W.). **Measuring magnitude of a defoliation disease of Tomatoes.**—*Phytopathology*, xxxii, 2, pp. 226–232, 1 graph, 1942.

McKinney's rapid technique for computing the extent of infection by a plant disease [*R.A.M.*, iii, p. 330] was applied at the New York State and Connecticut Agricultural Experiment Stations in 1938 and 1940, respectively, to the defoliation disease [early blight] of tomatoes (*Alternaria solani*), the John Baer variety being used in the former and Scarlet Dawn in the latter series of trials. Each plant is examined by walking cross-wise through the plots and assigned an arbitrary number ranging from 0 (no disease) to 4 (total defoliation). The ratings are added, divided by the total number of plants multiplied by four, and the quotient is multiplied by 100 for conversion into percentage, which is designated index of infection. This somewhat subjective method of gauging infection was found to bear a linear relation to the following more objective modes of recording the incidence of disease on the same plots: (1) percentage of leaves killed by the fungus, (2) percentage of fruits invaded by stem-end rot, (3) weight of green plants less fruits at time of reading, and (4) weight of green fruits at the end of the season. By the means described three men rated seven copper spray treatments in precisely the same order of efficacy as compared with a control plot (except in one instance), showing the technique to be valid, accurate, and reasonably objective, at any rate for a single series of fields or plots in a particular season.

COSTA (A. S.) & FORSTER (R.). **Identidade do virus de vira-cabeça e sua inclusão no grupo do virus do "spotted wilt".** [The identity of the 'vira-cabeça' virus and its inclusion in the group of the spotted wilt virus.]—*Bragantia, S. Paulo*, i, 7, pp. 491–506, 19 figs., 1941. [English summary.]

The writers tabulate and discuss the points of similarity between the viruses of spotted wilt, tomato tip blight [*R.A.M.*, xviii, p. 420], 'kromnek', 'corcova', Azevedo's tomato virus [ibid., xvi, p. 501], and 'vira-cabeça' [top necrosis: ibid., xx, p. 502], in respect of their physical properties, vectors, differential hosts, and host range, the conclusion being reached that the viruses in question, if not identical, are closely interrelated.

DEL CAÑIZO (J.). **Spain. A new method of controlling ink disease of the European Chestnut.**—*Int. Bull. Pl. Prot.*, xvi, 1, pp. 2M–3M, 1942.

The ravages of the ink disease (*Phytophthora cambivora*) are stated to be rapidly decimating the valuable chestnut stands of Spain [*R.A.M.*, viii, p. 152; xv, p. 540], where there are at present about 5,000,000 trees in production. Even in the province of Lugo, one of the least affected, the number of trees has sunk to half within the last 25 years, in La Coruña it has fallen to a sixth of the figure recorded at the opening of the present century, and in Pontevedra this source of income is practically exhausted. At this rate of progress a substantial source of wealth will be rapidly closed. In the hope of averting this danger experiments have been carried out since 1934 by P. Urquijo Landaluze in five provinces in the control of the pathogen by the application to the underground portion of the trunk and root base of an insoluble copper salt (usually the carbonate) previously mixed with an adhesive liquid [loc. cit.]. The treatment proved effective. The cost, calculated on the basis of 1938 prices, for 156 trees in the Asturias was 1·20 pesetas per tree for the chemical and 1·40 for the unskilled labour required. So successful has the method proved that it was extended by the Department of Agriculture in 1941 to a large number of groves comprising

thousands of trees. *P. cambivora* is believed to have entered Spain from two foci of infection, one in France [ibid., xvii, p. 356] and the other in Portugal.

Leach (J. G.) & Rupert (J. A.). **Black canker of Willow in West Virginia.**—*Plant Dis. Reptr*, xxv, 23, p. 588, 1941. [Mimeographed.]

Black canker (*Physalospora miyabeana*) [*R.A.M.*, xviii, p. 827; xxi, p. 172] has been found on two weeping willows [*Salix babylonica*] near Thomas, Tucker County, West Virginia. The disease was known to be present in 1939, but was not definitely identified until the summer of 1941. The fungus was isolated from the affected tissues, and both the perfect and imperfect stages were found fruiting on the cankers. This appears to be the first record of the disease from West Virginia.

Cash (Edith K.). **An abnormality of Abies balsamea.**—*Plant Dis. Reptr*, xxv, 22, p. 548, 1941. [Mimeographed.]

In December, 1939, an abnormal condition of the twigs of *Abies balsamea* shipped to New York from Newfoundland was observed by the plant quarantine inspectors and specimens were intercepted for further study. Similar material was later secured at Buffalo on *Abies* from Nova Scotia, at Boston on *A. balsamea* from New Hampshire, and in Colorado (by R. W. Davidson) on *A. lasiocarpa*. The apical stems bore an abundance of staminate blossom buds, the development of the terminal one frequently being arrested, with the result that branching was abnormally dense. The scales surrounding the staminate cones formed in previous years were still attached to the slightly swollen twigs, though the cones had fallen out. No fungi or other micro-organisms could be found in most of the specimens; but those from Newfoundland harboured black, depressed-globose sclerotia, surrounded by the cup-like sheaths formed by the above-mentioned basal scales. These sclerotia may possibly belong to *Sclerotinia kerneri*, described on *A. alba* in Austria by Wettstein in 1887, though the closer identification of the North American organism must await the development of the apothecial stage.

Pierce (R. G.). **Spread of White Pine blister rust in southern Appalachian States in 1941.**—*Plant Dis. Reptr*, xxvi, 2, pp. 54–55, 1942. [Mimeographed.]

During 1941 the agent of white pine blister rust, *Cronartium ribicola*, spread from Raleigh County, West Virginia, to McDowell County, North Carolina, a distance of 134 miles, thereby adding a continuous belt of 16 new counties to those already known to harbour the disease, with a total of 35 fresh infection centres. White pines [*Pinus strobus*] appeared to be free from infection in all the counties, the species of *Ribes* attacked being *R. cynosbati* in West Virginia, the same and *R. rotundifolium* in Virginia and North Carolina, *R. americanum* at one locality in the latter State, and *R. cynosbati* in Tennessee [cf. *R.A.M.*, xii, p. 407; xvii, p. 639, *et passim*]. The minimum altitude at which the rust was found was 1,750 ft. and the maximum 5,000 ft. Fifteen of the 25 sites for which data on the aspect of the bushes are available faced north, north-east, or north-west. Favourable conditions for the spread of *C. ribicola* from pines to *Ribes* prevailed in the four States concerned in late April (warm to hot, rainy, cloudy weather) and June, with three continuous wet spells from 1st to 5th, 8th to 15th, and 23rd to 30th, while in north-western North Carolina the persistent rainfall of July and August facilitated the dissemination of the uredospores from bush to bush.

Most of the valuable pine stands within the newly infected zones were already protected by the initial eradication of *Ribes*, so that this further southward extension of the rust is of no particular importance in connexion with its control. A certain amount of damage and loss among the few scattered trees situated outside the confines of the control areas must be accepted as inevitable.

HADDOW (W. R.). **Needle blight and late fall browning of Red Pine (Pinus resinosa Ait.) caused by a gall midge (Cecidomyiidae) and the fungus Pullularia (De Bary) Berkhout.**—*Trans. roy. Canad. Inst.*, xxiii, 2, pp. 161–189, 4 pl., 1941.

A full account is given of needle blight and late fall diseases of the foliage of red pine (*Pinus resinosa*) in Canada [*R.A.M.*, xix, p. 124], with which needle droop of the United States [ibid., xix, p. 445] is thought to be identical. The diseases may cause very severe defoliation, which could not be tolerated for many seasons. They are therefore potentially dangerous but where observed in Ontario they have come under natural control through parasitism before death of the trees resulted. A gall midge (Cecidomyiid) is the initiating agent of both diseases. Late fall browning is the result of injury caused by the larva of the gall midge alone, while needle blight results when there is infection of the bases of midge-infested needles by *Pullularia pullulans* (syn. *Dematium pullulans*, *Hormonema dematioides*, and *H. pullulans*).

The two diseases were not observed in natural forests; in forest plantations they occurred only in close, even-aged stands, mostly ten to twenty years old, needle blight being more favoured by wet and late fall browning by dry weather. Needle blight causes a bending of needles, which remain suspended in a hooked position on the lower branches as they drop, giving the trees an untidy appearance. The whole tree is usually affected by blight, but defoliation is slightly more severe towards the top and on the lower parts of branches. Extra-seasonal growth, sometimes leading to forking of the stem, either simple or multiple, is common, but rarely persists for many years. When scales were carefully removed from the blighted needles, dark, necrotic, and resinous lesions were exposed, from which *P. pullulans* was regularly isolated. Microscopic examination revealed the presence of the fungus in the mesophyll of the leaf, and both on the outside and the inside of the accessory foliar parts. The epidermal and hypodermal cells were sometimes discoloured, but mostly free from mycelium, as were also the vascular and transfusion tissues.

Typical needle blight occurs only when the bases of the needles are still succulent, which is usually in early summer. Late fall browning usually appears late in the season with great suddenness and intensity. Within a few days needles become completely brown from the base upwards and eventually die, without developing the bent or hooked appearance. A great measure of natural control was found to be exercised by Chalcid flies (mostly *Platygaster filicornis*) parasitic on the gall midge. It was also observed that spiders catching midges were unusually abundant in infested plantations.

BJÖRKMAN (E.). **Renkulturförsök med snöskyttesvampen (Phacidium infestans Karst.).** [Pure culture experiments with the snow leaf fall fungus (*Phacidium infestans* Karst.).]—*Svensk bot. Tidskr.*, xxxvi, 2–3, pp. 120–123, 7 figs., 1942. [German summary.]

An account is given of the writer's preliminary experiments at the Institute for Physiological Botany, Upsala, and in the open in Hälsingland, Sweden, with the snow leaf fall fungus (*Phacidium infestans*), a destructive pathogen of pines in the north of the country [*R.A.M.*, xvii, p. 86]. In the spring of 1940 samples of diseased needles and of the characteristic mycelium commonly found on them were collected and transferred to malt agar plates. Of the three kinds of mycelia which rapidly developed, one from the interior of a needle was proved to be pathogenic so that an etiological connexion between the mycelium and the snow leaf fall disease may be presumed. The pathogenic mycelium was observed to bear the typical fruit bodies of *P. infestans*, and additional evidence of its identity with *P. infestans* was provided by the fact that it formed anastomoses with mycelium from *P. infestans* spores. The average diameter of the spread of this mycelium was only 9 cm., so that the frequently formed and rapidly growing mycelia propagated through the snow are probably distinct.

Rennerfelt (E.). **Das Wachstum einiger Fäulnispilze auf Holzschliff.** [The growth of some rot fungi on mechanical pulp.]—*Svensk bot. Tidskr.*, xxxvi, 2–3, pp. 301–311, 4 figs., 1942.

Twenty wood-rotting fungi were examined for their capacity to disorganize sterilized mechanical pulp, pieces of which, measuring 7 by 1 cm. and 600 to 700 mg. in weight, were placed in Kolle flasks containing malt agar cultures of the various organisms and maintained at a temperature of 22° C. for two months. The heaviest loss of weight (25·4±1 per cent.) was caused by a strain of *Polyporus* [*Polystictus*] *versicolor* from the Gothenburg (Sweden) Botanical Garden, closely followed by another collection of the same fungus from the Eberswalde (Germany) College of Forestry (24·4±3·3 per cent.), the affected material being entirely overgrown and of a yellow- to dark-brown colour. Appreciable reductions in weight were further caused by a number of others, including *Lenzites betulina* [ibid., xiv, p. 645] (Gothenburg), *Fomes annosus* (Centraalbureau voor Schimmelcultures), *Polyporus arcularius* [ibid., xvi, p. 358] (Gothenburg), Basidiomycete K. 65 (Robak), *P.* [*Polystictus*] *hirsutus* [ibid., xvii, pp. 88, 758] (Gothenburg), *Coniophora cerebella* [*C. puteana*] (Eberswalde), and *Corticium calceum* (Robak in *Nyt Mag. Naturv.*, lxxviii, p. 113, 1938), with percentages of 21·0±2·0, 18·6±1·1, 18·1±1·6, 16·8±2·0, 16·8±1·0, 16·0±2·2, and 15·3±0·4, respectively. When the fungi were situated at right angles to the piece of pulp, their rate of penetration was slower than when they were growing parallel with the specimen: on the other hand, in the latter position the pulp absorbed water from the substratum with such velocity as to retard the growth of the organisms, which cannot tolerate a moisture content exceeding 210 per cent. [ibid., xviii, p. 360].

Pulp from eight grinderies was inoculated with *P. versicolor*, which caused a significantly heavier loss in weight in the two lots subjected to hydraulic pressure (25·6±3·7 and 22·9±1·4 per cent.) than in the remaining batches treated by the kamyr process (12·0±3·9 to 21·3±0·6 per cent.).

Copper treatment for wood.—*Timberman*, xliii, 2, p. 34, 1941.

H. S. Andrews, of the Olympia (Washington) Wood Preserving Co., has developed a new method of timber (especially piling) impregnation involving immersion in an electrified copper solution which penetrates the fibres to a depth of 3 in. A reagent is used which hardens the wood on its transference to salt water and increases its tensile strength by up to 30 per cent. A pile treated by this process in 1926 was examined in October, 1941, and found to be in a perfect stage of preservation, with no evidence of dry rot [*Merulius lacrymans*], the sapwood being also unaffected by the elements, giving a probable added duration of life of four to ten years. It is estimated that the durability of piling treated by this method would be extended to upwards of 40 years and dry rot entirely eliminated from bridge and other heavy constructional timbers.

Report of 31st annual inspection of C., B. & Q.R.R. experimental ties.—*Wood Pres. News*, xix, 1, pp. 1–5, 1941.

A tabulated account is given of the results of the 1940 inspection of the experimental sleepers laid on the tracks of the Chicago, Burlington and Quincy Railroad Company in 1909 and 1910, three lots of which impregnated with (1) coal tar creosote, full-cell process, 10 to 12 lb. per cu. ft.; (2) zinc chloride (Burnett) [*R.A.M.*, xvii, p. 2] ½ lb. per cu. ft.; (3) a mixture of the two foregoing (Card process) [ibid., xiv, p. 545], with an absorption of ½ lb. zinc chloride and 3 lb. creosote per cu. ft.; while one (4) was left untreated. The average percentages of 20 different species of hard and softwoods removed on account of decay among the four lots (lines east) were (1) 26, (2) 35, (3) 55, and (4) 90, respectively, and the actual average years of service to date (1) 28·5, (2) 19·1), (3) 16·1, and (4) 5·4, respectively, the corresponding figures for lines west being (1) 17, (2) 35, (3) 49, and (4) 91 per cent., respectively, and (1) 29·5, (2) 17·9, (3) 15, and (4) 5·8 years of service, respectively.

Report of Committee 4—Preservatives.—*Proc. Amer. Wood Pres. Ass.*, xxxvii, pp. 32–44, 1941.

In the section of this report dealing with the composition and use of timber preservatives it is stated that before 1932 the composition of Wolman salts (triolith) most generally used in the United States was 85 per cent. sodium fluoride, 5 per cent. potassium dichromate, and 10 per cent. dinitrophenol. The present compositions are: triolith, 55 per cent. sodium fluoride, 35 per cent. sodium chromate, and 10 per cent. dinitrophenol; and tanalith, 25 per cent. sodium fluoride, 25 per cent. disodium hydrogen arsenate, 37½ per cent. sodium chromate, and 12½ per cent. dinitrophenol.

Before 1931 the composition of zinc-meta-arsenite was 76 parts of zinc oxide, 198 parts of arsenic trioxide, and 155 parts of acetic acid; the present formula is 80, 120, and 140 parts of these ingredients, respectively.

These Proceedings also include, among numerous others, reports on the painting of creosoted wood, the pressure treatment of oak railway sleepers and lumber, of Douglas fir [*Pseudotsuga taxifolia*], of southern pine [*Pinus* spp.] sleepers and lumber, and of poles, on treated wood for car lumber, on the biological environment in treated wood in relation to service life, on preservatives in Mississippi fence posts, and on the quantity of wood treated and the preservatives used in the United States in 1940.

Buschlen (M. J.). **The control of Cercospora leaf spot.**—*Sugar*, xxxvii, 2, pp. 40–41, 43, 1 fig., 1942.

The first large-scale tests of dusting and spraying for the control of sugar beet leaf spot or blight (*Cercospora*) [*beticola*] in Ohio were undertaken in 1938, a season of severe infection, at the instigation of H. C. Young [*R.A.M.*, xxi, p. 178]. The results then secured indicated a potential yield increase of 1½ to 3 tons per acre, with a corresponding rise of 1 to 1·5 per cent. in the sugar content. The outcome of the 1939 trials in Ohio and Michigan (J. H. Muncie) pointed to yield increases of 1½ to 6 tons per acre and an average rise of 1·5 per cent. in the sugar content. Even in the comparatively dry season of 1940, which did not favour the pathogen, the general opinion was that the fungicidal programme paid in most of the beet-growing areas of Ohio. Several substitutes are now available for the original copper-lime dust, which presented various disadvantages, notably the need for application to damp foliage, i.e., usually at night, two in general use being tribasic copper sulphate and basic copper chloride (fixed), containing 50 to 55 per cent. metallic copper, made up in the proportion of 13 parts with 12 of bentonite or flour and 75 of talc and used at the rate of 35 to 40 lb. per acre at 10- to 14-day intervals. Spraying with Bordeaux mixture (3–6–100) is equally effective with dusting, but somewhat more costly owing to the time factor and inaccessibility of water on most farms; the rate of application should range from 90 to 100 gals. per acre.

Leach (L. D.). **Multiple Beets more susceptible to rot than singles.**—*Sug. Beet Bull.*, vi, 3, p. 16, 1 fig., 1942.

Thinning sugar beets in such a way as to produce a uniform stand of single plants has been found to be an important factor in the control of the southern sclerotial root rot fungus (*Sclerotium rolfsii*) in California [*R.A.M.*, xx, p. 618], the average percentages of infection in seven commercial fields in three counties of the Sacramento Valley being 8·7 and 26·4 for single- and multiple-plant stands, respectively, while in some fields the incidence of the pathogen in the latter was 2·4 to 4·2 times as high as in the former.

Jensen (J. H.) & Goss (R. W.). **Physiological resistance to halo blight in Beans.**—*Phytopathology*, xxxii, 3, pp. 246–253, 3 figs., 1942.

In inoculation tests at the Nebraska Agricultural Experiment Station with *Phytomonas* [*Pseudomonas*] *medicaginis* var. *phaseolicola* on the leaves, pods, stems, and

germinated seed [*R.A.M.*, xii, p. 742] of four bean [*Phaseolus vulgaris*] varieties, only small, inconspicuous, necrotic lesions developed on the foliage of Red Mexican and Schwert 27 (Hamburg Market) [cf. ibid., xv, p. 697] in contrast to the large, chlorotic areas formed on the susceptible Red Kidney and Bountiful [cf. ibid., xix, pp. 450, 451], suggesting the possession by the two former of physiological resistance. The aberrant symptoms were produced on resistant plants of all ages and over a wide temperature range (16°, 22°, and 28° C.). Pod inoculations induced on the two resistant varieties small, rust-coloured necrotic lesions instead of the common water-soaked type. The stem puncture and germinated seed methods of inoculation failed to bring about systemic infection. Tests (not described in detail) on other varieties resulted in the development on Schwert Nordstern of lesions similar to those on Red Mexican and Schwert, using all four methods of inoculation. Great Northern, Princess of Artois, Robust, Kaiser Wilhelm, and Marktsieger were likewise resistant to germinated seed and stem inoculations but reacted variably to those on the leaves and pods; White Seeded Runner and Zucker Brech were susceptible to seed infection only, Startler was resistant except to pod inoculations, which gave variable results, while Blue Lake was resistant to stem and pod inoculations and varied in its response to those on the foliage. In other trials with leaf and pod inoculations only, California Pink and Blue Pod were resistant, and Drouth Resistant and Arikara Yellow contracted no infection.

These data are regarded as indicative of the presence of true physiological resistance in the Red Mexican and Schwert No. 27 varieties and others reacting similarly to halo blight.

ZAUMEYER (W. J.). **Inheritance of a leaf variegation in Beans.**—*J. agric. Res.*, lxiv, 2, pp. 119–127, 1 fig., 1942.

A heritable foliar variegation in hybrid beans (*Phaseolus vulgaris*) having Corbett Refugee as one of the parents has been encountered in studies at the United States Horticultural Station, Beltsville, Maryland [*R.A.M.*, xviii, p. 7]. This variegation is considered to be identical with the 'one-sided mosaic' of Horsfall *et al.* (*Plant Dis. Reptr*, xxi, p. 318, 1937) but distinct from that described by Reinking and Withiam (*Canner*, xc, p. 12, 1940). The data for its inheritance support a two-factor Mendelian hypothesis.

On the primary leaves the colour changes induced by the abnormality may range from a slight chlorotic streaking or mottling to a virtual absence of the normal green pigmentation, accompanied by reduction in size. Such leaves usually die. The trifoliate leaves are commonly sectored, with only small yellow areas on a normal green background, the variegation being often confined to one side of the leaflet, which almost or quite ceases to grow, resulting in curling and distortion. A necrotic streaking or spotting may develop on the petioles and affected parts of the leaflets. Rosetting and considerable stunting, with shortened internodes and adventitious bud production in the leaf axils, are prevalent in seriously diseased plants, which at best bear only a few twisted, curled, and shrunken, discoloured pods, whereas a normal seed crop may be obtained from those less severely attacked. The foliar variegation under discussion has also been observed in a small number of Wisconsin Refugee and Idaho Refugee beans grown in Colorado and Idaho.

A second similar but heritably distinct variegation has been observed affecting the trifoliate leaves only.

MÜLLER (A. S.). **Enfermedades de las Caraotas, Frijoles y Habas en Venezuela.** [Diseases of Beans, Cowpeas, and Lima Beans in Venezuela.]—*Agricultor venez.*, vi, 65–66, pp. 18–22, 4 figs., 1941.

The symptoms, etiology, and mode of dissemination, of the following diseases affecting beans (*Phaseolus vulgaris*) in Venezuela are described and measures for their

control recommended: rust (*Uromyces appendiculatus*), to which Red Kidney is resistant, mildew (*Erysiphe polygoni*), *Sclerotium rolfsii*, *Rhizoctonia* [*Corticium*] *solani*, mosaic (Red Kidney and Dwarf White Navy resistant), anthracnose (*Colletotrichum lindemuthianum*: Red Kidney and Tuerbarao resistant), *Ascochyta pisi*, *Cercospora canescens* [*R.A.M.*, xvi, p. 492], *C. columnare* [ibid., xv, p. 60], and *R.* [*Corticium*] *microsclerotia* [ibid., xix, pp. 3, 294], the two last-named also on *P. lunatus*. Cowpeas are attacked by *C. cruenta* [ibid., xvi, p. 492; viii, p. 505].

Wormald (H.). **Black rot of Carrots.**—*Gdnrs' Chron.*, Ser. 3, cxi, 2887, p. 172, 1 fig., 1942.

Stored carrots submitted for inspection to the East Malling Research Station were found to be affected by a black rot caused by an *Alternaria* agreeing with the description of *A. radicina* given by Meier *et al.* in New York State [*R.A.M.*, ii, p. 5]. The conidial dimensions varied with the number of septa, e.g., 15 to 21 by 9 to 12 μ with one septum, 18 to 25 by 10 to 15 μ with two, 27 to 36 by 12 to 16 μ with three, and 33 to 42 by 11 to 12 μ with four; conidia with four or five transverse septa and one to five longitudinal walls measured 38 to 51 by 14 to 27 μ, while one spore with five transverse septa but no longitudinal walls was 33 by 14 μ. Sunken, dark areas, 1 to 2 cm. in diameter, bearing chains of spores, developed in a fortnight on carrots inoculated in the laboratory. The fungus, of which this appears to be the first authentic published record in England, though its occurrence was suspected by Salmon and Ware in 1934 [ibid., xiii, p. 354] and confirmed by the latter in 1938, grew well on prune agar. Diseased roots should be sorted out before storage and burnt, not thrown on the compost heap, where they might act as soil contaminants, endangering the next year's crop.

Elmer (O. H.). **The use of spergon for Sweetpotato seed and sprout treatments.**—*Plant Dis. Reptr*, xxvi, 2, pp. 44–46, 1942. [Mimeographed.]

In preliminary tests in 1941 at the Kansas Agricultural Experiment Station a spergon [*R.A.M.*, xxi, p. 245] (Naugatuck Chemical Division, United States Rubber Company) dip gave satisfactory control of stem rot [*Fusarium oxysporum* f. 2 and *F. bulbigenum* var. *batatas*] of sweet potatoes, besides exerting a stimulatory effect on the seed. Thus, the number of Little Stem Jersey sprouts produced by spergon-treated seed (2 oz. per gal., momentary dip) in hot-beds was 1,735, compared with 1,109 for semesan bel (same rate) [ibid., xix, pp. 327, 388], 988 for mercuric chloride (1 in 1,000 for 10 minutes), and 1,305 for the controls. Sprout treatments, also consisting of a momentary dip, were made in two commercial fields with spergon (2 oz. per gal.) and semesan bel (1 oz. per 5 pts). One of the fields was heavily infested by the pathogens, the untreated controls (Nancy Hall) showing 55·3 per cent. stem rot as against only 7 and 10·9 for the spergon- and semesan bel-treated plots, respectively, while the corresponding yields were 198·3, 324·2, and 269·8 bush. per acre, respectively. In the second field (Little Stem Jersey) the yields from the control, spergon- and semesan bel-treated plots amounted to 419·1, 519·2, and 465·6 bush. per acre, respectively.

Johnson (H. W.) & Lefebvre (C. L.). **Downy mildew on Soybean seeds.**—*Plant Dis. Reptr*, xxvi, 2, pp. 49–50, 1942. [Mimeographed.]

The examination, at the Division of Forage Crops and Diseases of the (United States) Bureau of Plant Industry, of diseased Mammoth yellow soy-bean seed of the 1941 crop disclosed a solid mass of globose, hyaline oospores, 23 to 32 μ in diameter, with smooth walls 3 μ in thickness, the epispore on staining with cotton blue in lactophenol sometimes showing irregular reticulations, which increased the diameter measurements given above by 3 to 9 μ. Macroscopically the seeds appeared to be covered with a milky-whitish crust, and the coats were wrinkled and cracked. The

causal organism is believed to be identical with *Peronospora manshurica* [*R.A.M.*, xvi, p. 585; xix, p. 192], previously regarded exclusively as a foliar disorder in the United States, though reported to be seed-transmissible. It would appear from these observations, however, that the downy mildew, at any rate in certain seasons, may assume economic importance as an agent of damage to the seed crop.

LINN (M. B.). **Leaf-spot disease of cultivated Salsify.**—*Phytopathology*, xxxii, 2, pp. 150–157, 2 figs., 1942.

Stemphylium botryosum Wallr. [*R.A.M.*, xviii, p. 141] var. *tragopogoni*[*s*] n. var. is the name applied to a fungus responsible for foliar spotting, chlorosis, and withering of salsify (*Tragopogon porrifolius*) in small-scale commercial plantings of less than two acres on Staten Island, New York, where the annual loss from this source is estimated at 5 per cent. The fungus causes the formation of light brown lesions on the tips of the older leaves, followed by minute, light brown, necrotic spots surrounded by light green areas on the leaf blade. These lesions enlarge to 3 to 4 mm. in diameter and become cinnamon-brown with ashen-grey centres. Severely affected leaves turn yellow and wither. Though the symptoms induced by the fungus under observation somewhat resemble those due to *Sporodesmium scorzonerae*, the two pathogens are entirely different in other respects. The new variety is distinguished from *Stemphylium botryosum* proper only by its longer conidia (17 to 56 by 8 to 26 as compared with 24 to 39 by 19 to 31 μ), which are ovoid-oblong to subangular, light brown, minutely verrucose, with one or more longitudinal and up to three transverse septa and are borne on fasciculate, occasionally branched conidiophores of the same colour, 25 to 180 by 4 to 5 μ. Good growth was made on potato dextrose agar at an optimum temperature range between 21° and 27° C. Under appropriate conditions of temperature and high humidity, salsify plants inoculated with spore suspensions of the fungus developed lesions within 48 to 60 hours. The epidemic occurrence of the disease is attributed largely to soil-borne inoculum furnished by old, infected leaves from the previous crop, experimental evidence having indicated that the risk of transmission of the fungus by commercial seed is negligible. Satisfactory control of the leaf spot may be obtained by bi-weekly applications of Bordeaux mixture 4–4–50 or cuprocide 54 (1¾ lb. per 50 gals. water), plus a suitable spreader, such as pyrolene M.P. (Standard Agricultural Chemicals) or Ultrawet (Atlantic Refining Co.), beginning during the first week in July and continuing until a week before harvest in early October.

KEN KNIGHT (G.). **Peanut diseases in certain Texas counties in 1941, with notes on occurrence of Peanut rust.**—*Plant Dis. Reptr*, xxv, 23, pp. 587–588, 1941. [Mimeographed.]

In 1941 excessive rainfall during the spring caused much damage to groundnuts in southern Texas. A seedling blight, apparently caused by a species of *Fusarium*, produced rotting of the tap roots. Leaf spot, due primarily, if not wholly, to *Cercospora personata* [*R.A.M.*, xxi, p. 65] caused slight to moderate defoliation in 5 of 37 fields surveyed. Southern blight (*Sclerotium rolfsii*) [ibid., xix, p. 579] was noted in 11 of 19 fields in Wilson County, causing losses of yield ranging from under 1 to 12 per cent. In Atascosa County one of three infected fields showed 25 per cent. loss of yield. In Frio County it had clearly caused serious loss in one partly harvested field. In an experimental field in Wilson County it reduced the yield by at least 50 per cent. In contrast to what was observed in 1940 death of immature plants as a result of infection was common, reaching 10 per cent. in some rows, and sclerotia were abundantly present on the roots and pods of affected plants both in the experimental field and in all other fields where the disease was found. In a ⅛ acre garden plot of Jumbo-Runner groundnuts some 10 per cent. of the plants had been killed off by *S. rolfsii* when observed on 3rd November.

Rust (*Puccinia arachidis*) [ibid., xix, p. 261] appeared on several selections in an experimental field in Wilson County early in October. On 28th October the disease was present in all of seven fields of Spanish groundnuts in Frio County, but was causing appreciable damage in only one, in which the leaves had a scorched appearance. These appear to be the first records of groundnut rust in Texas.

WELCH (A.) & MELHUS (I. E.). **Wilt resistance in F_1 hybrid Watermelons.**—*Phytopathology*, xxxii, 2, pp. 181–182, 1942.

In 1937 at the Iowa Agricultural Experiment Station a selection from the watermelon variety Dixie Queen susceptible to wilt (*Fusarium bulbigenum* var. *niveum*), inbred for three generations, was crossed with a wilt-resistant inbred selection from a three-way cross (Iowa Belle × Jugoslavia 7, back-crossed on Iowa Belle), with a view to the development of a round, striped, resistant watermelon. The F_1 progeny of this cross were 70 to 85 per cent. wilt-resistant [*R.A.M.*, xvi, pp. 14, 369, 439]. In September, 1940, 71·4 per cent. of the plants raised from the F_1 seed were alive, the remainder having been killed by the fungus. In another test the F_1 progeny of two out of twelve crosses, viz., Japan 7 × Thurmond Grey and Japan 7 × Dixie Queen, proved 80 per cent. wilt-resistant; the incidence of resistance in the other ten ranged from 50 per cent. to nil, the 35 susceptible Dixie Queen controls all being killed. The discrepancy between these results and those of Orton (*Proc. Soc. hort. Sci.*, p. 28, 1907) and of Porter and Melhus [*R.A.M.*, xi, p. 557], who found resistance to wilt to be a recessive character in the F_1, may be attributable to the use in earlier breeding experiments of citron melons as the resistant parents instead of watermelons as at present.

THOMAS (K. M.). **Detailed Administration Report of the Government Mycologist for the year 1940–41.**—*Rep. Dep. Agric. Madras, 1940–41*, pp. 53–74, 1941.

All the 77 rice selections tested at the Central Farm, Coimbatore, for their reaction to blast (*Piricularia oryzae*) [*R.A.M.*, xx, p. 148] proved to be more or less susceptible, the percentage of infection ranging from 19·1 in No. 4055 to 80·6 in No. 4012. Two new selections, 11348 and 10998, which showed only 0·8 and 1·9 per cent. infection, respectively, last year, contracted 38·1 and 42·8 per cent., respectively, during the period under review. The results of experiments to determine the influence of the sowing date on the incidence of blast in ten varieties showed the heaviest infection to occur in the September plantings, with a gradual decline through October to November (when a minimum of 0·2 per cent. was registered for Co. 4 and Adt. 6) for seven of the selections tested.

Experiments were conducted to ascertain the influence of infected seed and soil, severally or combined, on the development of *Helminthosporium oryzae* [*Ophiobolus miyabeanus*] in rice seedlings, with the following results. Infected seeds gave rise to 24·6 and 22·3 per cent. disease in sterilized sand and soil, respectively; infected seeds in infected sand and soil to 40·3 and 29·8 per cent., respectively; and healthy seeds in infected sand and soil to 31·9 and 26·1 per cent., respectively, the incidence of the pathogen in the control plots (soil only) being 5·2 per cent. It is apparent from these data that both seed and soil can serve as sources of infection. When artificially infected seeds were sown in sand and kept for a fortnight at three different temperatures, no germination occurred at 10° C., while at 15° the percentages of diseased seedlings and mortality were 60 and 46, respectively, and at 28° to 29° 38·6 and 12, respectively, from which it is evident that the blight would assume a very severe character in cold weather. *O. miyabeanus* was experimentally shown to be pathogenic to rice at all stages of development from seedling to ear head and to attack all organs, e.g., leaves, leaf axils, and ears, indiscriminately. Both strains of the fungus used were capable of attacking the foliage of tenai [*Setaria italica*], cumbu [*Pennisetum typhoides*], and sugar-cane. Ten minutes' immersion of the diseased seed in water

heated to 55° reduced the incidence of infection in the Mtu 7, 8, and 9 selections from 100 to 20, 92 to 24, and 88 to 20 per cent., respectively.

None of the 15 ragi [*Eleusine coracana*] selections tested for their reaction to blast (*Piricularia* sp.) was resistant, but E.C. 155 was relatively free from infection, contracting only 24 and 28 [24 and 29 in the table] per cent. in the July- and August-sown crops, respectively, compared with up to 89 per cent. in E.C. 1507. The period of severe infection from the end of October to mid-December coincided with a high degree of atmospheric humidity (79 to 92 per cent.) and a rainfall of 17·4 in. between the times of flowering and harvest. The drier conditions prevailing during the ripening of the October-sown crop, harvested in the first 12 days of February, led to a decrease in infection (6 to 31 per cent.), while the crops sown from January to June and in November and December were free from disease. Heavy seedling infection does not necessarily connote a high incidence of blast in the transplanted crop, which may, in fact, be remarkably healthy. Seedlings were shown by inoculation experiments to be more susceptible than older plants, while tests on discoloured seeds of E.C. 593 revealed the presence of the pathogen on the surface in 5 to 42 per cent. of those that failed to germinate. In cross-inoculation experiments with *Piricularia* spp. *P. oryzae* from rice and the species from *Panicum repens* were pathogenic only to their own hosts, *Piricularia* sp. from *E. coracana* attacked its own host and wounded leaves of *S. italica*, while conversely *P. setariae* from the latter infected *E. coracana*: neither *P.* sp. from *E. coracana* nor *P. setariae* was pathogenic to rice or *Panicum repens*.

Only two of the 54 red gram [*Cicer arietinum*] varieties tested for their reaction to wilt (*Fusarium vasinfectum*) showed any appreciable degree of resistance, namely, Pusa 80 and Bulsar White (0 and 2·5 per cent. infection, respectively, as against 51·2 to 100 in the remainder).

The bunch-type groundnut A.H. 45 was the most resistant to wilt (*Macrophomina phaseoli*) of the 20 varieties tested, with 9·2 per cent. infection compared with up to 29·4 and 44·1 in the other bunch and spreading selections, respectively. March- and April-sown crops of the susceptible Mozambique A.H. 42 contracted heavy infection (38·9 and 35·8 per cent., respectively), compared with only 4 per cent. in the May-planted.

In trials on the effect of the mode of inoculation on the amount of red rot (*Colletotrichum falcatum*) developing in sugar-cane, introduction through bore holes in the setts resulted in the maximum percentages of 89, 87, and 27 per cent. in Co. 419, Poovan, and Co. 281, respectively, followed by inoculation of the cut ends with a culture of the fungus (76 and 22 per cent. in Co. 419 and Co. 281, respectively), and mixing fragments of diseased cane with the soil (16 per cent. in Co. 413), no infection being produced by smearing the culture on the root bands.

As in previous years the Co. 205 (Pusa), 422, 434, 508, 511 and Uba (S.H. 38) sugar-cane varieties continued to show resistance to mosaic, which was further absent from Co. 411, 432, and Uba (S.H. 281), formerly slightly susceptible.

In connexion with a study of cotton seedling blight and boll rot a comparison was made between the causal organism, *C. indicum* [ibid., xix, p. 259; xx, p. 149], *C. curcumae* [ibid., xi, p. 545], *C. capsici* [ibid., xx, p. 317], and *C.* spp. from local cotton, *Aristolochia*, and Bengal gram, the results of which showed all the different isolates to be merely strains of a single species, for which the earliest name is *C. capsici*.

The treatment of Cambodia cotton seed with 1 per cent. formalin, ceresan, or agrosan G did not impair germination for immediate or delayed sowing (up to 45 days), and eliminated all trace of primary infection by angular leaf spot (*Phytomonas* [*Xanthomonas*] *malvacearum*) which developed in the controls.

Orange trees sprayed against leaf and fruit fall (*Phytophthora* sp.) [ibid., xx, p. 149] with 1 per cent. Bordeaux mixture in the pre-monsoon or monsoon periods or in both showed 32·02, 19·96, and 6·22 per cent. fruit fall per tree compared with 71·94 per

cent. in the control. In another test with 0·5 per cent. oil-Bordeaux mixture, the pre-monsoon, monsoon, and both applications were equally effective against leaf fall, while fruit fall was again better controlled by two treatments than by one, and by the monsoon than by the earlier spray, the percentages of infection per tree in the pre-monsoon, monsoon, two-spray, and control plots being 38·2, 28·6, 24, and 47, respectively.

Acid limes and rough lemons have shown immunity from the forms of gummosis and root rot affecting Vadlapudi oranges (*Citrus maderaspatna* Tanaka) in the Bezwada district, and it is hoped to utilize this character in the development of permanent methods of control of a serious disease.

Storage rot (*Pythium* sp.) of ginger rhizomes [ibid., xx, p. 150] was effectively combated by immersion for 1½ hours in 0·1 per cent. mercuric chloride or for 30 minutes in 0·25 per cent. agrosan G.

Plant diseases. Notes contributed by the Biological Branch.—*Agric. Gaz. N.S.W.*, liii, 2, pp. 91–94, 4 figs., 1942.

The spike-harrow system of steam sterilization is stated to be gaining in favour among growers of glasshouse tomatoes in the Sydney metropolitan area, though the inverted pan method is still widely used elsewhere in New South Wales. A pair of steam harrows costs about £24, as against £14 for a pair of pans, but the former will treat a standard house (96 by 15 ft.) in about 10 hours (with a Sentinel boiler), while 16 hours are required for the latter. Also, two men can operate the steam harrow system, while three are required for the pan.

Effective control of passion fruit [*Passiflora edulis*] brown spot (*Alternaria passiflorae*) [*R.A.M.*, xix, p. 420] is possible only when spraying is carried out in advance of the disease. The vines should be pruned at least once a year, and this operation should be followed by application of Bordeaux mixture (6–4–50) at monthly intervals in spring and summer and at intervals of two months during the cooler months. The spray must reach the inner portions of the vines.

Dowson (W. J.). **The generic name of the Gram positive bacterial plant pathogens.**—*Trans. Brit. mycol. Soc.*, xxv, 3, pp. 311–314, 1942.

The great majority of bacterial plant pathogens are Gram-negative [*R.A.M.*, xx, p. 197], but for the six well-authenticated Gram-positive species a genus other than those used for the accommodation of the Gram-negative forms must be sought. The species in question have all been referred by Bergey [ibid., xix, p. 203] to *Phytomonas* as *P. fascians* Tilford, *P. flaccumfaciens* (Hedges) Bergey, *P. insidiosa* (McCulloch) Bergey, *P. michiganensis* (Erw. Smith) Bergey, *P. sepedonica* (Spieckermann) Magrou, and *P. rathayi* (Erw. Smith) Bergey. However, since the genus *Phytomonas* comprises both Gram-negative, motile and Gram-positive non-motile forms, it is unacceptable to most bacteriologists, besides having been proved invalid by Miss Elliott [ibid., xvii, p. 302] and the author [ibid., xviii, p. 658].

In this connexion reference is made to the genus *Corynebacterium* Lehmann & Neumann, which was studied by H. L. Jensen (*Corynebacteria* as an important group of soil micro-organisms.—*Proc. Linn. Soc., N.S.W.*, lviii, pp. 181–185, 1933; lix, pp. 19–60, 1934). They are described in Bergey (p. 791) as non-motile, without endospore formation, Gram-positive, non-acid-fast, normally rod-shaped but with a strong tendency to the development of irregular, club- or wedge-shaped, sometimes branching cells, multiplying by a characteristic 'snapping' division, which causes the bacteria in microscopic preparations to appear in V- or III-like patterns or irregular groups comparable to Chinese letters. Among the species found to be abundant in certain grass soils of New South Wales were two closely resembling, and subsequently found to be identical with, *P. insidiosa* and *P. michiganensis*, for which Jensen recommended the names *Corynebacterium insidiosum* and *C. michiganense*, respectively. It is further

apparent from the investigations of Tilford [*R.A.M.*, xvi, p. 102] and Miss Lacey [ibid., xviii, p. 597] that *P. fascians* also agrees in its erratic mode of development and other features with *Corynebacterium*.

Taking these data into consideration, the writer advocates the following nomenclature for the six phytopathogenic bacteria under discussion: (1) *Corynebacterium sepedonicum* (Spieckermann) n.comb., the agent of potato ring rot; (2) *C. rathayi* (Smith) n.comb., causing yellow slime disease of cock's foot grass [*Dactylis glomerata*]; (3) *C. michiganense* (Smith) Jensen, responsible for Grand Rapids disease or bacterial canker of tomato; (4) *C. insidiosum* (McCulloch) Jensen, the agent of lucerne bacterial wilt; (5) *C. flaccumfaciens* (Hedges) n.comb., causing a systemic bean (*Phaseolus*) disease; and (6) *C. fascians* (Tilf.) n.comb., the causal organism of sweet pea and strawberry fasciation and of leafy galls on various ornamentals. Of these, only Nos. (2) and (6) have been recorded for Britain.

Jamieson (M. C.). **Requisites for the recognition of the blue-green Pseudomonas.**—*Sci. Agric.*, xxii, 7, pp. 401–409, 1942.

This is a study of two generic characters of the genus *Pseudomonas*: pigment production and fluorescence. Pigment production was found to require sulphate, phosphate, and magnesium. These were present in nutrient media prepared in tap water, which favoured pigmentation, while the same media made with distilled water were found unsuitable. Pigmentation was less pronounced on the nutrient agar slants than in the liquid media. The most suitable media for routine tests and research purposes were modified Sullivan's 'K' medium and a combination of this with nutrient milk agar.

For the demonstration of fluorescence in cultures a 400-watt Mazda ultra-violet lamp was used. Under this light the cultures on media prepared with tap water were bright and of yellow, green, greenish blue, blue, and dark blue colours, while all those on media made with distilled water and also cultures of *Achromobacter* on all media were of a dull blue fluorescence. Cultures of *Pseudomonas* streaked on agar slants and colonies from pure culture platings displayed fluorescence under ultra-violet light many days before they showed pigmentation in daylight. The ultra-violet technique is, therefore, recommended as a more accurate and rapid method than any based on the observation of pigment. Recognition on subsurface colonies by the ultra-violet method is rendered possible by puncturing the agar above such colonies with a sterile needle and thereby allowing the access of air for part of the incubation period. In the modified synthetic medium 'K' the differences in colours of fluorescence are stated to be so marked as to suggest the possibility of differentiating species and strains of *Pseudomonas* by this means. Further research is, however, required for the determination of the various fluorescent colours. It is noted that there appears to be a direct correlation between the fluorescent colours of the pigments and the P_H produced by various cultures.

Mallmann (W. L.), Botwright (W. E.), & Churchill (E. S.). **The selective bacteriostatic effect of slow oxidizing agents.**—*J. infect. Dis.*, lxix, 3, pp. 215–219, 1941.

The slow oxidizing agents, potassium dichromate and sodium azide, were experimentally shown to exert a bacteriostatic action in appropriate dilutions, e.g., 1 in 10 000, on Gram-negative bacteria in nutrient media, while permitting the growth of Gram-positive organisms, especially *Staphylococcus* spp.

Lichtle (P. C.), Standring (Elizabeth T.), & Brown (J. G.). **A bacterial necrosis of the Giant Cactus.**—*Phytopathology*, xxxii, 4, pp. 303–313, 5 figs., 1942.

Erwinia carnegieana Standring n.sp. is the name proposed for the bacterium implicated in the widespread and destructive necrosis of the giant cactus (*Carnegiea*

gigantea) in southern Arizona [*R.A.M.*, xx, p. 394]. The organism is a greyish-white, actively motile, peritrichiate, Gram-positive, non-sporulating rod, 1·6 to 2·9 by 1·1 to 1·8 μ, liquefying gelatine very slowly at 20° C., reducing nitrates, not coagulating milk, occurring singly or in pairs, producing on the surface of poured agar plates circular, slightly raised, smooth, greyish-white, wet-shining colonies with an entire, well-defined margin, and evolving acid and gas from arabinose, dextrose, galactose, levulose, maltose, sucrose, raffinose, mannitol, and salicin. The differences between *E. carnegieana* and two other bacterial pathogens of Cactaceae, viz., *Bacterium cactivorum* on *Cephalocereus senilis* in Italy [ibid., xiv, p. 765] and *Bacillus cacticidus* on *Opuntia* in South Australia [ibid., iii, p. 707], are tabulated and briefly discussed. Certain similarities between the new disease and soft rot due to *E. carotovora* suggested the possible identity of the two causal organisms, but their morphological and biochemical differences, as well as the failure of cross-inoculation experiments, excluded this interpretation.

Greaney (F. J.) & Machacek (J. E.). **Prevalence of seed-borne fungi on cereals in certain seed inspection districts of Canada.**—*Sci. Agric.*, xxii, 7, pp. 419–437, 1942.

Seed surveys and pathological tests made with a large number of samples of wheat, oat, barley, and rye seed-grain of the 1939 and 1940 crops from different districts of Canada showed that among the numerous organisms isolated species of *Alternaria* were the most common, though not harmful, and species of *Helminthosporium* and *Fusarium* were the most important pathogens. *H.* spp. (mainly *H. sativum* on wheat, barley, and rye, *H. teres* on barley, and *H. avenae* on oats) were much more prevalent than *F.* spp. on wheat and barley, while on oats *F.* spp. were found as frequently as *H. avenae*. In greenhouse tests high positive correlations were found between the percentage of seeds infected with *H. sativum* and *H. avenae* and the amount of disease subsequently developing in the seedlings. The surveys indicate that seed-grain infection in Canada varies widely from year to year, from province to province, and even from field to field. Thus, the total amount of wheat, oats, and barley seed-grain infection was greater in Manitoba in 1940 than it was in 1939; on the other hand, oats and barley seed-grain infection in the eastern provinces was greater in 1939 than it was in 1940. In 1939 the cleanest wheat seed-grain came from Saskatchewan, and rye seed-grain from Saskatchewan and British Columbia yielded no organisms in 61 and 71 per cent. of the kernels, respectively; samples of oats and barley seed-grain from Manitoba, Alberta, and British Columbia were relatively free from infection by *H.* and *F.* spp., while those from the Maritime Provinces, Quebec, and Ontario were severely attacked. In 1940, samples of oats and barley seed-grain from the Maritime Provinces were more severely infected with these fungi than were those from Manitoba. The great majority of the wheat samples tested in 1940 were virtually free from smut fungi, while oats and barley samples were carrying a heavy smut spore load, sufficiently dangerous to require seed treatment. Attention is consequently drawn to the necessity for seed treatment of oats and barley for the control of smut. In greenhouse tests, seed treatment of infected wheat, oats, and barley with an organic mercury dust almost completely controlled diseases caused by *H.* and *F.* spp. and improved germination of the infected seed, but it had little or no effect on the germination of clean seed if sown in clean soil. It is considered that the results of these studies have proved the practical value of annual seed-borne disease surveys and pathological seed-grain tests to seed-producers and grain-growers.

Vanterpool (T. C.) & Sprague (R. A.). **Pythium arrhenomanes on cereals and grasses in the northern Great Plains.**—*Phytopathology*, xxxii, 4, pp. 327–328, 1942.

Pure-culture isolations from cereals and grasses in North Dakota in 1940–1 revealed the prevalence of *Pythium arrhenomanes*, especially in the lighter soils of the central regions, the same fungus having also been collected on wheat, maize, and grasses in

Minnesota and South Dakota, and wheat in eastern Montana. *P. aristosporum* Vanterpool, occasionally isolated from wheat affected by browning root rot in Saskatchewan [*R.A.M.*, xix, p. 696], was obtained from barley and wheat in North Dakota and Montana, respectively. In 1941 the disease first appeared about 10th May and continued to develop for two months, though *P. arrhenomanes* was recovered from warm-temperature grasses, e.g., *Setaria italica*, until early August, and from wheat in the Red River Valley as late as 29th July. *P. de Baryanum* and several congeneric forms were isolated from grasses with damping-off in the early part of the season and later following rainy periods. Thatcher wheat seedlings grown at Saskatoon, Saskatchewan, and Mandan, North Dakota, contracted moderate to severe infection following inoculation with *P. arrhenomanes* from the following naturally diseased hosts: *Aegilops triuncialis*, *Agropyron amurense*, *A. caninum*, *A. ciliare*, *A. cristatum*, *A. dasystachyum*, *A. intermedium*, *A. pungens*, *A. repens*, *A. trachycaulum*, *Ammophila arenaria*, *Bouteloua curtipendula*, *B. gracilis*, *Brachypodium sylvaticum*, *Bromus carinatus*, *B. erectus*, *B. inermis*, *Echinochloa crus-galli*, *Elymus glaucus*, *E. interruptus*, *E. junceus*, *Festuca rubra* var. *commutata*, barley, *Panicum miliaceum*, rye, *S. italica*, *S. viridis*, *Stipa comata*, wheat, *Triticum dicoccum*, *T. durum*, and maize. The fungus was further isolated from *Agropyron desertorum*, *A. riparium*, *A. spicatum*, *A. trichophorum*, *Arrhenatherum elatius* [*A. avenaceum*], cultivated and wild oats, *Sorghastrum nutans*, sorghum, and Sudan grass, but the pathogenicity of cultures from these hosts remains to be tested.

Reed (G. M.). **Inheritance of smut resistance in hybrids of Navarro Oats.**—*Amer. J. Bot.*, xxix, 4, pp. 308–314, 1942.

In further studies on the inheritance of resistance to *Ustilago avenae* and *U. levis* [*U. kolleri*: *R.A.M.*, xx, p. 525; xxi, p. 251] in oats, the variety Navarro was found to be resistant to all the known races of both smuts tested. Crosses of Navarro with other varieties were made in 1936 and the data on the resistance to smut of the F_2 and F_3 generations of hybrids from these crosses, studied during the following five years, are presented as follows. The behaviour of hybrids from the cross Navarro × Hull-less indicated a two-factor relation for inheritance of resistance in the case of race 1 of *U. avenae* and a three-factor difference in that of races 1 and 7 of *U. kolleri*. The results obtained with race 12 of *U. avenae* were in striking contrast to those obtained with the previous races, indicating a very different basis for the inheritance of resistance: of a total of 121 F_2 plants inoculated with this race, 62 were infected; of a total of 225 F_3 plants, 26 were resistant, 86 segregating, and 113 susceptible.

The behaviour of hybrids from the cross Navarro × Black Mesdag indicated at least five independent factors for resistance to races 7 and 9 of *U. kolleri* and three factors to race 12 of *U. avenae*. The behaviour of hybrids from the cross Navarro × Gothland suggested the presence of two factors for resistance to race 1 of *U. avenae*.

All the four parental varieties used in these tests were resistant to race 10 of *U. avenae*; however, an occasional F_3 progeny of Navarro × Hull-less and Navarro × Gothland contained 1 to 13 infected plants. No infected plants were observed in the F_3 progenies of Navarro × Black Mesdag.

Koehler (B.). **Natural mode of entrance of fungi into Corn ears and some symptoms that indicate infection.**—*J. agric. Res.*, lxiv, 8, pp. 421–442, 1 pl., 7 figs., 1942.

In a study of maize ear rots conducted during 1933, 1935, and 1937, unsterilized natural tissues from maize ears (Reid Yellow Dent variety) in various stages of development and mature surface-sterilized whole and dissected kernels were plated on agar medium, and histological sections of kernels examined. *Fusarium moniliforme* [*Gibberella fujikuroi*: *R.A.M.*, xx, p. 57] was found to be the most prevalent organism in maize ears. In most cases infection by this fungus and *Cephalosporium acremonium* originated in the region of the silks, spreading thence to the kernels,

pedicels, vascular cylinder, and finally the shank. Only in very few cases did *G. fujikuroi* infection proceed in the opposite direction, from shank to kernel. *C. acremonium* also commonly infected the lower half of the kernel surface, progressing down the ear in the region where the glumes occur; in a few cases the fungus reached the kernels by way of the butt of the cob, vascular cylinder, and pedicels. Internal kernel infection by either fungus did not become established until the ears were approaching maturity.

Infection by *G. zeae* [*G. saubinetii*] nearly always started at the tip ends of the ears, spreading downwards most rapidly in the region of the silks. *Diplodia zeae* and *Nigrospora* spp. (*N. oryzae* and *N. sphaerica*) entered the ear either at the tip or rather more frequently at the butt end, the latter type being very largely the result of local infection on the shank. *D. zeae* caused a more active and more extensive rot behind the advancing mycelium than any of the other fungi. A species of *Monilia*, which was very prevalent in some seasons, appeared to enter the ears exclusively in the region of the silks, readily invading the pedicels and vascular cylinder and penetrating in some few cases through to the butt of cob. No internal kernel infection was found. Infections by several species of *Penicillium* occurred later in the season and were less prevalent than those by *G. fujikuroi*, but the mode of penetration was similar; internal kernel infection was, however, practically absent.

Infection by *G. fujikuroi* and to a lesser extent by *G. saubinetii*, was increased by earworm (*Heliothis armigera*) damage to the tip of the ear; that by *N.* spp. and *C. acremonium* was only very slightly increased, and that by *D. zeae* did not appear to be affected by this factor. Discoloration under the husk at the butt end of otherwise healthy-looking cobs was found to be strongly indicative of infection by *D. zeae*, *N.* spp. and *G. fujikuroi*, while infection by *C. acremonium*, *G. saubinetii*, and *Penicillium* spp. was little or not at all correlated with discoloration. *Nigrospora* infection was strongly related to shredded shanks. Internal kernel infection by all fungi studied was found to be most common in the tip cap, and, in a decreasing order of prevalence, in the tissues of the germ, the floury endosperm, and the horny endosperm. White streaks on the pericarp of kernels yielded *G. fujikuroi*, *C. acremonium*, and *N.* spp. The white colour is believed to be due to the disintegration of the cells which cease to be transparent and take on a chalky appearance.

Cass-Smith (W. P.), Owen (R. C.), & Harvey (H. L.). **Water spot of Navel Oranges in relation to the application of white oil sprays and various other orchard practices.**—*J. Dep. Agric. W. Aust.*, Ser. 2, xviii, 4, pp. 267–284, 4 figs., 1941.

During the past few years, in the upper south-west area of Western Australia, where 30 in. or more of rain (some 80 per cent. of the annual total) fall during ripening and harvesting, mature Navel oranges have been found to rot on the trees, mainly owing to attack by water spot. This trouble, not before recorded from Western Australia, closely resembles water spot in California [*R.A.M.*, xvii, p. 390; xx, p. 299]. Laboratory investigations showed that the disease is caused by imbibition of water by the rind, typical symptoms resulting when oranges were immersed in trays of water.

In field experiments in 1940 it was found that spraying 72 trees with white spray oil (1 : 40) much increased the incidence of water spot and citrus pit, and also rendered rinds more susceptible to slight injuries by rubbing against leaves and twigs, such injuries being known to favour water spot [ibid., xvii, p. 671]. On the average, losses in sprayed fruits were three times greater than in the unsprayed.

Losses due to water spot began earlier on the sprayed than on the unsprayed fruits. Thus, avoiding white oil sprays may give a longer disease-free picking period, but liability to the condition increases with maturity, so that if heavy rain falls in late July and August considerable loss from water spot may result even on non-oiled trees.

Field studies indicate that a correlation exists between the continued application

of heavy fertilizer dressings rich in readily available nitrogen and the incidence of the disease. The practice of growing leguminous cover crops during winter is, however, a cheap and effective aid to the maintenance of both soil nitrogen and humus content, and deserves encouragement.

When clean oiled and non-oiled oranges were loosely packed in sterilized cases and stored for 11 weeks, the oiled fruits showed 11 per cent. loss by moulds (*Penicillium* spp.) as against only 4·2 per cent. for the non-oiled.

In a further experiment oranges from trees not receiving the oil spray were placed in shed storage after being treated with a 2 per cent. concentration of wax emulsion, with the same material plus one per cent. concentration of shirlan AG, and with one per cent. shirlan AG only, with untreated controls, half the oranges in each case being wrapped in sulphite paper wraps. In all treatments the fruit kept for 16 weeks without excessive loss from [unspecified] moulds or storage spot, but when held three weeks longer rapid deterioration set in. The paper wraps were not very effective in preventing spread of infection, and apparently it would be better and cheaper to remove affected fruits at frequent intervals.

Schiel (E.). **La lucha contra Sphaceloma australis, parásito del Mandarino en la Provincia de Santa Fe.** [The campaign against *Sphaceloma australis*, a parasite of the Tangerine in the province of Santa Fe.]—*Rev. argent. Agron.*, ix, 1, pp. 19–27, 1942. [English summary.]

A tabulated account is given of the author's experiments in 1938–9 and 1940–1 in the control of scab (*Sphaceloma* [*Elsinoe*] *australis*) on severely affected tangerines in the province of Santa Fe, Argentina, from which he concludes that commercially adequate results are obtainable by two applications of 1 per cent. Bordeaux mixture, the first to be given just before flowering and the second when at least three-quarters of the petals have fallen [*R.A.M.*, xvii, p. 170].

Rae (M. Viola). **A case of obscure pulmonary infection : observations on lung infection roentgenologically tuberculous but bacteriologically yielding a pathogenic yeast and non-pathogenic acid-fast bacillus.**—*Canad. publ. Hlth J.*, xxxiii, 1, p. 40, 1942.

A report from the Mountain Sanatorium, Hamilton, Ontario, illustrates the confusion arising from the presence of acid-fast saprophytes in sputum and gastric washings in a case roentgenologically [*R.A.M.*, xx, p. 61 *et passim*] suggesting pulmonary tuberculosis, but inducing no symptoms. Culture repeatedly yielded a chromogenic, acid-fast bacillus non-pathogenic to guinea-pigs and hens, while *Monilia* [*Candida*] *albicans* was also isolated from the sputum and gave positive results in experiments on rabbits, rats, and guinea-pigs. The fungus was concluded to be the responsible agent in the production of the pulmonary condition, with the acid-fast bacillus acting as a non-pathogenic contaminant.

Frank (T. J.). **Bronchopulmonary moniliasis.**—*Melbourne Hosp. clin. Rep.*, xii, 2, pp. 11–17, 1 pl., 1941.

A case of bronchopulmonary moniliasis, possibly of the primary type, in a 62-year-old woman is fully described and critically discussed under its clinical, diagnostic, and therapeutic aspects. *Monilia* [*Candida*] *albicans* developed in profusion in cultures from the sputum on Sabouraud's medium, and X-ray photographs [cf. preceding abstract] revealed widespread lung infiltration, especially involving the bases. Attention is drawn to the unsuspected prevalence of pulmonary moniliasis and its close simulation of tuberculosis.

Martin (D. S.). **The practical application of some immunologic principles to the diagnosis and treatment of certain fungus infections.**—*J. invest. Derm.*, iv, 6, pp. 471–481, 1941.

The immunological data obtained in a limited number of cases of deep-seated fungal infection are presented and correlated with the results of various therapeutic procedures. Nine out of 17 patients (53 per cent.) suffering from blastomycosis (*Blastomyces* [*Endomyces*] *dermatitidis*) reacted positively to complement fixation, 9 out of 16 (56 per cent.) to skin tests, and 14 out of 17 (82 per cent.) to one or other, or both, of these methods. The diagnosis of moniliasis is much more difficult to establish than that of blastomycosis because of the high incidence of *Candida albicans* in the sputum and intestinal tract of persons in normal health. A positive reaction to this organism, therefore, is significant only in a patient with pulmonary infection whose sputum discloses the constant presence of *C. albicans*.

Bernstein (T. B.) & Feinberg (S. M.). **Air-borne fungus spores. A five-year survey of daily mold spore content of Chicago air.**—*J. Allergy*, xiii, 3, pp. 231–241, 9 graphs, 1942.

During the five-year period (1935 to 1939) covered by the authors' observations, *Alternaria* and *Hormodendrum* spp. constituted 72 per cent. of all the fungi developing on potato dextrose agar plates exposed daily for 15 minutes outside an upper window at the Northwestern University Medical School, Chicago. A decided seasonal trend was apparent in both these groups: in general, the maximum spore concentration (80 per cent. in the case of *Alternaria*) occurred from June to November, while the period of activity of *Hormodendrum* commenced earlier (in April) and continued longer (through December). The other two predominant moulds (*Aspergillus* and *Penicillium*) showed no tendency to seasonal fluctuation [*R.A.M.*, xxi, p. 290].

Jensen (H. L.). **Micro-organisms active in the dew-retting of Flax.**—*Aust. J. Sci.*, iv, 2, p. 59, 1941.

The micro-organisms responsible for the 'dew-retting' of flax, the cultivation of which has undergone a rapid expansion in Australia since the outbreak of war, have not been studied at all in that country and not to much extent elsewhere, and a preliminary investigation of this problem was conducted at the University of Sydney from March to May, 1941. Flax straw taken from the field in various stages of decomposition, or incubated in a moderately humid condition in the laboratory, was found to harbour an abundant flora of bacteria, yeasts, and filamentous fungi, of which the last-named proved to be the true agents of retting [*R.A.M.*, iii, p. 87], though some activity in this direction was also shown by the white and pink forms of *Torula*, not hitherto observed in this capacity. *Bacterium herbicola* and *Bacillus mesentericus*, the predominating bacteria, were found to be incapable of retting sterile flax straw, the water-soluble components of which apparently served as their main source of sustenance. As regards the fungi, in the laboratory *Mucor* sp. and *Cladosporium herbarum* were most abundant at low temperatures (8° to 10° C.), *Rhizopus nigricans*, *C. herbarum*, and *Alternaria* spp. in the middle range (24° to 30°), and *Aspergillus* spp. in a warm atmosphere (37°). The field straw yielded principally *Dematium* [*Pullularia*] *pullulans*, *C. herbarum*, and *Alternaria* spp. All these organisms were capable of more or less rapid retting of the straw, but those with dark mycelia produced a fibre of the same dark colour as the natural dew-retted flax, while some, notably species of *Alternaria* and *Stachybotrys*, caused speedy weakening and destruction of the fibre. Theoretically, the Mucoraceae and Aspergillaceae would be the most appropriate fungi for dew-retting operations, since they neither discolour the fibre nor reduce its tensile strength; unfortunately, however, their activities do not extend to the field. This is apparently the first record of *P. pullulans* as an agent of retting. In this connexion it may be of interest to note that the three actively

retting fungal genera are also prevalent among the sooty moulds of New South Wales [ibid., xiv, p. 60; xvi, p. 700].

Baker (K. F.) & Thomas (H. Earl). **The effect of temperature on symptom expression of a Rose mosaic.**—*Phytopathology*, xxxii, 4, pp. 321–326, 1942.

In tests under controlled conditions at the University of California, Berkeley, on two rose varieties, Peerless and Rome Glory, symptoms of mosaic [*R.A.M.*, xix, p. 409] were shown to be favoured by temperatures ranging from 15° to 25° C. but to be much reduced in severity below 15°. Both under the carefully regulated conditions of the experiments and in the variable atmosphere of a greenhouse the symptoms developed in an entirely erratic fashion, a given leaf adjacent to a diseased one sometimes contracting infection and in other cases remaining healthy, while even companion leaflets frequently responded dissimilarly. Commercial rose-growing is usually carried on in greenhouses with diurnal and nocturnal temperature ranges of 20° to 25° and 14·5° to 17°, respectively, under which conditions the recognition and removal of severely diseased plants should be quite practicable, though there is little fear of the spread of infection under glass. In the field the situation is not so clear, and it may well be advisable to select budwood for large-scale plantings from mosaic-free greenhouse material.

Jenkins (Anna E.). **Poinsettia scab caused by Sphaceloma.**—*Phytopathology*, xxxii, 4, pp. 336–337, 1942.

The species of *Sphaceloma* responsible for poinsettia (*Euphorbia pulcherrima*) scab in a nursery at Honolulu, Hawaii, where considerable damage was observed in November, 1939, appears from specimens submitted by E. A. Bessey to the writer in 1941 to be identical with that reported by Ruehle on the same host from Florida [*R.A.M.*, xxi, p. 142]. Simultaneously with the outbreak of the disease on poinsettia the same or a similar trouble was observed on *Pedilanthus* sp. in a private garden, but further material is necessary in this case to establish the identity of the causal organism.

Burton (G. W.) & Lefebvre (C. L.). **Potash deficiency symptoms in Napiergrass, Pennisetum purpureum.**—*J. Amer. Soc. Agron.*, xxxiv, 4, pp. 372–375, 2 figs., 1942.

Strains of Napier grass (*Pennisetum purpureum*) resistant to eye spot (*Helminthosporium sacchari*) [*R.A.M.*, xxi, p. 21] have done well at the Georgia Coastal Plain Experiment Station in respect of high yields and winter-hardiness, but they tend to suffer from potash deficiency, expressed by the formation of irregular, brown spots on the leaves, sometimes accompanied by 'firing' of the tips and margins. These symptoms are more acute and develop earlier in the very leafy strains than in those with sparser foliage. The depletion of potash giving rise to the pathological condition is tentatively attributed to the large amounts of the element consumed by the plant in its copious leaf production. A cure was effected by the application of potassium chloride to the soil at the rate of 200 lb. per acre. The heavy withdrawal of potash by the Napier grass resulted in severe spotting of an adjacent planting of velvet beans [*Mucuna deeringiana*], indicating exhaustion of the available supplies over a distance of 8 to 10 ft.

McKinney (H. H.), Fellows (H.), & Johnston (C. O.). **Mosaic of Bromus inermis.**—*Phytopathology*, xxxii, 4, p. 331, 1942.

A yellow mosaic was observed in the spring of 1941 on *Bromus inermis* at the Kansas Agricultural Experiment Station, whence the diseased plants were transferred to Arlington Farm, Virginia, for inoculation tests with the virus, which proved pathogenic to its own host, Harvest Queen wheat, and White Tartar oats. Dried diseased

tissues after 51 days' storage at summer room temperatures, contained sufficient active virus to induce mosaic in all 12 wheat plants inoculated. None of the seven wheat viruses previously enumerated by the first-named author (*Circ. U.S. Dep. Agric.*, 442, 22 pp., 1937) gave positive results on *B. inermis*, the virus of which is therefore assumed to be distinct.

Stephenson (R. B.). **Sterilization technique for grass seeds.**—*Plant Physiol.*, xvii, 2, pp. 324–325, 1942.

In experiments at the University of Illinois to determine the relative merits of various sterilization procedures for the disinfection of Kentucky bluegrass [*Poa pratensis*] seed without impairment of germinative capacity, the mercury-containing preparations, semesan, semesan bel, and ceresan dust, were lethal to the seed, and calcium hypochlorite [*R.A.M.*, xviii, pp. 115, 228] was inadequate as a cleanser, but very satisfactory results, both as regards germination and freedom from infection were obtained by a one-minute dip in 95 per cent. alcohol followed by two hours' immersion in 2 per cent. calcium hypochlorite or 30 minutes in a 10 per cent. solution of the same compound (filtered), the latter being the writer's routine method. Subsequent germination of the seeds should be carried out on 2 per cent. agar, which is preferable to moist filter paper both as a source of moisture and for the detection of contaminants.

Beck (A. B.). **A survey of the copper content of Western Australian pastures.**—*J. Dep. Agric. W. Aust.*, Ser. 2, xviii, 4, pp. 285–300, 1 map, 1941.

Details are given of chemical analyses of the copper content of some 200 samples of pastures growing in different parts of Western Australia [cf. *R.A.M.*, xxi, p. 347]. Samples obtained from areas in which stock show symptoms of copper deficiency were found to contain under 3 p.p.m. of copper (dry basis), while samples from sound areas contained over 5 and usually 7 to 12 p.p.m.; values between 3 and 5 p.p.m. are regarded as marginal. It was ascertained that the copper content of a pasture falls as it approaches maturity; heavy grazing also brings about a heavy reduction in copper. There was some indication that chemical analysis of *Cryptostemma calendulaceum* does not always give a correct indication of the copper status of soils. Copper deficiency is widely prevalent in Western Australia, though in some parts it may be confined to small pockets of certain soil types. The lateritic Darling Ranges may possibly be deficient in copper.

Modlibowska (Irena) & Field (C. P.). **Winter injury to fruit trees by frost in England, 1939–40.**—*J. Pomol.*, xix, 3, pp. 197–207, 2 pl., 1942.

Good results in the treatment of frost injury to fruit trees were obtained at East Malling by nailing down the cracked and loosened bark firmly to the wood by two rows of small-headed nails (§in., 20-gauge, gimp pins) on each side of the cracks, using a light hammer. Vaseline was applied to the cracks to prevent drying out. On some trees, the nails were driven through small squares of rubber to prevent the heads from sinking into the bark. Healing was more rapid and satisfactory in the nailed than in untreated trees.

Kidd (F.) & West (C.). **Refrigerated gas storage of fruit. V. Conference, Doyenné du Comice, and Williams' Bon Chrétien Pears.**—*J. Pomol.*, xix, 3, pp. 243–276, 4 pl., 1942.

A full account is given of investigations carried out at East Malling, Kent, from 1934 to 1940, on the reaction of stored Conference, Doyenné du Comice, and Williams' Bon Chrétien pears (home-grown) to the composition of the storage atmosphere. In these studies, different combinations of the three variables (1) carbon dioxide concentration, (2) oxygen concentration, and (3) temperature were tested.

When Conference pears were stored in air (within 24 hours of gathering) at temperatures ranging from 34° to 64·4° F., at all the temperatures tested except the lowest the fruit passed from the hard, green condition, through the firm-ripe, melting-ripe, and over-ripe stages to the stage of 'sleepiness' which begins at the core and spreads through the flesh. This condition is termed 'core breakdown' [cf. *R.A.M.*, xx, p. 412], and is accompanied by a fall in the rate of carbon dioxide production.

At 34° in air the pears softened very slowly and eventually showed signs of yellowing. Softening was not enough to render the pears eating-ripe, and the sweetening, when it occurred, was accompanied by an unpleasant aldehydic flavour. This condition was followed by browning and mealiness of the flesh after some six months' storage, here termed 'low temperature internal breakdown'. If the pears were removed from the low temperature (34°) not later than about 3½ months from date of picking, they ripened normally at all three ripening temperatures tested, viz., 64·5°, 53·6°, and 45·5°. If maintained at 34° for about a fortnight longer, they ripened normally at the two higher ripening temperatures, but not at 45·5°. After any further period of storage at 34°, the pears, though appearing firm and sound on removal, did not ripen normally at any temperature.

In the gas storage trials with Conference pears only a small amount of brown heart [ibid., xix, p. 284] was observed. It developed early in the storage life and tended to increase with the storage period. Apparently, higher storage temperatures, higher percentages of carbon dioxide, and lower concentrations of oxygen are all associated with increase in brown heart.

An experiment was conducted in which the storage life of Conference pears picked on 19th September, 1938, and immediately stored, was compared with that of others picked on the same day and kept for 4, 10, and 13½ days at 53·5° before being placed in storage. The storage conditions used were cold storage in air at 34° and gas storage at 34° (in 5 per cent. carbon dioxide, 2·5 per cent. oxygen, and 92·5 per cent. nitrogen). The results showed that the pears stored after more than four days' delay in air at 53·5° were a failure, owing to internal breakdown in the cold-stored fruit and brown heart in the gas-stored. This experiment shows that pears must be placed in store and that the appropriate conditions of temperature and atmosphere must be established before the beginning of the climacteric rise in respiratory activity.

When Comice pears were kept under different conditions of gas storage at 34° and 31·5° the higher temperature was found to be unsuitable owing to the amount of brown heart that developed. Taking, as an example, the storage atmosphere that gave the best results (10 per cent. carbon dioxide, 2·5 per cent. oxygen, and 87·5 per cent. nitrogen), after 180 days the pears showed 5 and 75 per cent. brown heart at 31·5° and 34°, respectively. The maximum storage life obtained in this atmosphere was five months, as compared with four months in synthetic air at the same temperature. Under most of the storage conditions tested a few fruits became affected by scald.

As brown heart was the limiting factor in these tests of the refrigerated gas storage of Comice pears, and all the atmospheres used contained at least 5 per cent. of carbon dioxide, Comice pears were submitted to further trials, using gas mixtures containing low concentrations of both oxygen and carbon dioxide. In these the longest storage life, about five months, was obtained in two atmospheres both of which contained 3 per cent. of carbon dioxide with 2·5 and 5 per cent., respectively, of oxygen. This storage life was the same as the longest obtained in the earlier tests in an atmosphere consisting of 10 per cent. of carbon dioxide, 2·5 per cent. of oxygen, and 87·5 per cent. of nitrogen. In air the fruit kept well for 3½ months, as compared with four months previously. In spite of the low concentrations of carbon dioxide used, some brown heart developed in gas storage late in the storage life. In addition, a diffused browning of the flesh immediately beneath the skin, but not externally visible, developed to a limited extent, especially in the atmosphere consisting of 5 per cent. carbon dioxide,

2·5 per cent. oxygen, and 92·5 per cent. nitrogen. Towards the end of the tests a few fruits showed typical scalding of the skin.

With Bon Chrétien a small amount of brown heart developed in atmospheres containing 10 per cent. carbon dioxide at storage temperatures of 34° and 37°.

In an appendix it is stated that in 1941–2 many Conference pears developed without seeds and with only a rudimentary core. This fruit, when fully developed, had an abnormally high respiratory activity both in the pre-climacteric and climacteric phases, and developed 33 per cent. brown heart in gas storage, even when the concentration of carbon dioxide used was that previously found to give the best results with this variety.

Trout (S. A.), Tindale (G. B.), & Huelin (F. E.). **Investigations on the storage of Jonathan Apples grown in Victoria.**—*Bull. Coun. sci. industr. Res. Aust.* 135, 96 pp., 4 pl., 16 graphs, 1940. [Mimeoprinted.]

This is a progress report on investigations begun in Victoria in 1924 into various factors influencing storage wastage of Jonathan apples [*R.A.M.*, xx, pp. 340, 476; xxi, p. 3] from several climatically different districts. Wastage in these apples is stated to be mainly due to soft scald, breakdown, Jonathan spot, and to a lesser extent to [unspecified] mould and brown heart. Maturity of the fruit at picking was found to be of the greatest importance in relation to all these forms of wastage. The most reliable index of maturity is the respiratory activity of the fruit after picking, but its application is not commercially practicable. A fairly reliable index of maturity of the fruit from a particular district is the ground colour, i.e., the colour of the unblushed portion of the fruit. A special colour chart is supplied with the bulletin showing the four colours: deep green of the immature fruit, which is not very susceptible to storage disorders, but of poor flavour; two shades of green-yellow of the ripening fruit, which gradually improves in taste and texture, but also becomes increasingly susceptible to soft scald and breakdown; and finally the deep yellow of the over-mature fruit, which loses its crisp and firm texture, becoming soft and slightly mealy and still more susceptible to these two disorders. The green-yellow stage of maturity is considered the most suitable for picking. Jonathan spot was observed to develop in both immature and over-mature fruit, while the effect of maturity on mould incidence was variable from year to year. Wastage from soft scald was consistently greatest at a storage temperature of 32° F. and could generally be controlled by storage at 36° to 37°. Maximum development of soft scald was always reached in cool storage between June and July. Breakdown was observed to occur at all temperatures (in some seasons over a range from 32° to 65°) and was always of the mealy type. Its incidence was greatest at 32° and least at 37°, the most mature fruit being the most susceptible. The development of Jonathan spot and mould was increased to a much greater extent by an increase of storage temperature from 34° to 37° than by one from 32° to 34°.

The effects of delayed storage prior to storage at 32° seemed to vary from year to year, the fruit becoming either more or less susceptible to disorders according to the stage of picking maturity. Protracted periods of delayed storage at temperatures of 36° and 45° produced a progressive decrease in subsequent soft scald development at 32°, while at higher temperatures (55° and 65°) scald incidence usually first increased with short periods of delay and then decreased with further delay, the fruit losing its susceptibility more slowly than at lower temperatures. It is considered possible that soft scald may be caused by too sudden cooling. Delayed storage had varying effects on breakdown or mould development. As for Jonathan spot, delayed storage controlled it in immature fruit, but increased it in mature fruit. On the basis of above observations, it is suggested that the practice of leaving the fruit in the shed after picking is to be avoided on account of rapid deterioration in quality after about a fortnight. For overseas export prompt cooling of apples after picking to 36° or 40°

(but not 32° or 34° because of possible development of low temperature disorders, which may occur even after a storage period of nine weeks) is recommended with subsequent shipping at 34° to 36°. For local storage a delayed storing at 36° till the end of April followed by a month at 34° prior to storing at 32° is advocated. It is mentioned that a number of cool stores have adopted this method since 1937 with very satisfactory results.

Gas storage at 36° in concentrations of carbon dioxide as high as 5 per cent. maintained the fruit in better condition than storage in air at the same temperature, but concentrations of 10 per cent. caused serious wastage.

The largest fruit was found to be the most susceptible to breakdown and possibly to soft scald; the smallest appeared to be most susceptible to Jonathan spot. The amount of wastage seemed to vary greatly in different districts and from season to season, and to be independent of the position of the fruit on the tree. Apples from trees yielding light crops were generally more susceptible to breakdown than similar ones from trees bearing heavy crops. The storage life of the Jonathan apple depends on maturity at picking, storage temperature, seasonal and orchard conditions, but, in general, 10 per cent. of wastage develops by the end of September. There was no consistent relationship between wastage and humidity conditions in the store. The cane sugar : acid ratio was correlated with ground colour at picking and with keeping quality of the fruit, but the results showed that differences in amount of wastage between districts cannot be attributed to differences in any chemical constituent.

16. Konferenz über Bekämpfung von Krankheiten und Schädlingen der Obstbäume. [16th conference on the control of fruit tree diseases and pests.]—*Schweiz. Z. Obst- u. Weinb.*, li, 6, pp. 93–124; 7, pp. 139–172, 2 diags., 5 figs., 2 graphs, 1942.

At the 16th conference on the control of fruit tree diseases and pests, convoked by the Federal Experiment Station for Fruit Growing, Viticulture, and Horticulture, Wädenswil, and held in Zürich on 31st January, 1942, C. Hadorn reported on the trials conducted during 1941 in eight climatically divergent localities on the treatment of apple scab [*Venturia inaequalis*: *R.A.M.*, xx, p. 411], from which the following practical conclusions are drawn. 'Concentrated' lime-sulphur (32° Beaumé) is recommended as the standard spray, to be applied at a strength of 2 per cent. before and 1 per cent. after the emergence of new growth. For varieties sensitive to lime-sulphur injury, e.g., Sauergrauech, Danzig Kant, Berne Rose, Berlepsch, and Winter Citron, pomarsol (1 per cent. for pre-blossom and calyx sprays, 0·75 per cent. later) may be substituted. Both lime-sulphur and pomarsol may be mixed with 0·15 to 0·2 per cent. copper oxychloride, containing 32 per cent. metallic copper (Bordo-Xex or virikupfer [viricuivre: ibid., xviii, p. 87]) which improves adhesiveness and enhances efficacy. The 'maximum' schedule of eight applications, as opposed to the 'normal' of five, is of great importance for susceptible apple varieties in situations where the scab fungus flourishes; four treatments at short intervals during blossoming will turn the scale in the right direction, while one too few may endanger the crop. Examples are cited in confirmation of last year's conclusions to the effect that late scab occurs exclusively in the train of primary infections, which must be combated by the above-mentioned spring treatments and that, without the latter, belated applications, e.g. at the end of July, will be useless.

R. Wiesmann's large-scale tests to determine the possibility of combining the dormant treatments (4 to 5 per cent. carbolineum plus 2 per cent. copper oxychloride) against apple scab and insect pests showed that satisfactory results could not be achieved in this manner, since the insects can be exterminated only by early applications (up to 6th March at the latest), while in the interests of fungal control it is desirable to wait until the first signs of new growth appear.

C. Hadorn, investigating the mode of operation of the so-called 'reserve spray', which he defines as the 'controlling factor in a scab control schedule, aiming at the

combination of a minimum of summer treatments with a maximum of security', finds the most effective formulae of those tested up to the present to be the original 'blue spray' with 4 per cent. Bordeaux mixture, and the 'brown spray', consisting of 4 per cent. Bordeaux plus 1 per cent. lime-sulphur. The object of this treatment, applied immediately before the emergence of new growth, is to furnish a sufficient 'reserve' of fungicidal material to be liberated and dispersed with every shower during the critical post-emergence to post-blossom period of primary scab infection. Prior to 1939 little was known concerning the proportion of copper requisite for the destruction of the conidia of *V. inaequalis*; in preliminary tests with copper carbonate at Wädenswil, germination was inhibited by the presence of 3·7 gm. in 100 l. water—a very high figure compared with the traces sufficient to inactivate the spores of other fungi, e.g., *Sclerotinia* [*fructicola*] and *Glomerella* [*cingulata*] [ibid., xvii, p. 541]. The German phytopathologist, W. Maier, secured important information on this matter by his combined laboratory and field experiments (*Z. PflKrankh.*, xlix, p. 160, 1939) at Geisenheim [Rhine], where he sprayed pear trees against scab [*V. pirina*] with 6 per cent. Bordeaux mixture immediately before emergence. The copper concentration in rain water dripping from the leaves and branches was found to decrease progressively as time went on, the amounts present in 1 c.c. on 21st April, 8th June, and 13th August being 4·8, 2·4, and 0·4 γ, respectively. Pyramids and palmettoes lost their copper reserves more rapidly than standard trees, on which the spray deposit on the bark is better protected by the foliage. The texture of the cortex is another important factor in this connexion; the smoother the surface, the more rapid the washing-off of the mixture. According to Maier, 1 or preferably 2 γ copper in 1 c.c. water (0·1 to 0·2 gm. per 100 l.) is the lower safety limit for effective scab control, and during the critical period covered by his tests a concentration of 4 to 5 γ was present at the time of maximum risk. Confirmatory experiments were undertaken along the same lines at Wädenswil, where the following treatments were given: one Gravenstein standard sprayed with 4 per cent. 'blue', one with 'brown', consisting of 5 per cent. lime-sulphur plus 2 per cent. copper oxychloride, one bush-trimmed Gravenstein and one Golden Pearmain with 6 per cent. 'blue', while one bush-trimmed Kassel Reinette and one Red Astrakhan were merely covered with fishing nets steeped for five hours in 6 per cent. Bordeaux mixture, and one each of the same kind with coco-nut matting similarly impregnated. Rain water was collected from each of the treated trees at the end of every wet day or brief period (a week at the longest) and stored in the refrigerator until required for determination. Analyses by C. Zäch [reported below] showed 0·1 γ copper per c.c. to be the minimum dose compatible with safety. The highly susceptible Kassel Reinettes remained entirely free from scab under the impregnated nets and matting, the water dripping from which evidently sufficed to confer protection, whereas a tree of the same variety receiving the 'normal' schedule of treatments contracted 90 per cent. infection. The covered Red Astrakhans showed only slight infection from 18th June until the autumn, whereas those treated in the ordinary way were severely attacked. Seeing that 0·2 gm. copper per 100 l. water is ample to prevent scab infection, the amounts hitherto used for 'reserve' sprays (4 per cent. Bordeaux mixture containing 1,000 gm. and 2 per cent. copper oxychloride with 640 gm. per l.) must be deemed excessive.

C. Zäch tabulates and discusses the results of his analyses of the rain water collected from the trees treated by the various methods described above. The total copper contents per sq. m. for the 4 per cent. 'blue', 'brown', and 'red' (2 per cent. copper oxide) mixtures (standard apples) being 0·914, 0·294, and 0·486 gm., respectively, or calculated per tree, 18·3, 5·9, and 9·7 gm., respectively, the corresponding figures for bush-trimmed trees covered with (*a*) nets, (*b*) matting, or (*c*) sprayed with 6 per cent. 'blue' being 0·16, 0·143, and 1·38 gm. per sq. yd. or 2·0, 1·8, and 17·4 gm. per tree.

C. Hadorn's observations showed that no leaf injury worth mentioning was caused by the intensive treatment of Boiken, Gravenstein, Golden Pearmain, and Danzig

Kant apple trees with lime-sulphur alone or in combination with iron sulphate, lead arsenate alone, lime-sulphur or pomarsol with nirosit (a new German insecticide, also known as No. 23.52), or pomarsol with lead arsenate, whereas mixtures of lime-sulphur and lead arsenate tend to induce severe injury under favouring climatic and environmental conditions. Recent determinations by C. Zäch further point to the importance of the water-soluble copper content and the hydrogen-ion concentration of the mixture in relation to spraying damage, the maximum amount of copper consistent with safety being less than 0·5 per cent. and the most suitable reaction about P_H 7·0. Preparations complying with these conditions in the 1941 trials included 0·15 to 0·2 per cent. copper oxychloride, bordo-xex, bordofix, oxykupfer, viricuivre, cryptocid, estafat, and the 1934 and 1938 brands of cupromaag.

Peglion (V.). **La base biologica della lotta contro la ticchiolatura del Melo e del Pero.** [The biological basis of the campaign against Apple and Pear scab.]—*Ital. agric.*, lxxix, 1, pp. 9–14, 1942.

Following a survey of outstanding developments in the life-histories of apple and pear scab (*Venturia inaequalis* and *V. pirina*) as described in the relevant literature, the writer summarizes and discusses the results of large-scale orchard experiments in the control mainly of the first-named in the Ferrara district of Italy in the spring of 1941, when meteorological conditions were exceptionally favourable to the progress of the disease. The standard Bordeaux mixture schedule, consisting of a 2 per cent. dormant application, another at the opening of the buds at 0·5 to 0·8 per cent., and a third at the same strength when the flowers were beginning to unfold, produced an excellent crop, but the winter treatment was experimentally shown not to be indispensable provided the spring spraying was punctually carried out. This statement is not applicable to the control of *V. pirina*, at any rate on susceptible pear varieties, for which the dormant treatment of 2 per cent. Bordeaux mixture plus ammonium chloride or sulphate is a necessity. Of recent years the increasing copper shortage has induced many fruit-growers to treat apple scab with lime-sulphur instead of Bordeaux mixture, but there is considered to be no justification for such a measure, which has been attended by serious consequences in the case of varieties susceptible alike to *V. inaequalis* and lime-sulphur injury, e.g., Commercio, Imperatore, Rome Beauty, Calvilla, Rambour F., Abbondanza, and Renetta Walder. Particularly good results were obtained by the use of Bordeaux mixture, commencing at a strength of 0·7–1–100 and decreasing to 0·5–0·8–100, two applications being given before the blossom, one at the close of flowering, and subsequently at ten-day intervals, except in the case of sensitive varieties, such as Gravenstein and Imperatore, which developed severe russeting of the fruit, the foliar scorching due to the same cause being quite transient. G. Gerbaldi's experiments at Ravenna in 1940-1 (on which much of the information here presented is based) showed that the best fungicide for Black Ben Davis, a hypersensitive variety as far as scorching injury is concerned, is a cold mixture of sulphur and lime.

In the autumn of 1940 abundant conidial rudiments of *V. inaequalis* and *V. pirina* were observed for the first time in the Trentino on apple and pear branches, respectively, and by the following May were in full fructification.

Yeager (A. F.). **Mild versus lime-sulphur.**—*Amer. Fruit Gr.*, lxii, 2, pp. 16–17, 1 fig., 1942.

Flotation and other forms of mild sulphur are being largely substituted for lime-sulphur in the control of apple scab [*Venturia inaequalis*] in New Hampshire [*R.A.M.*, xx, p. 104]. The yields of clean McIntosh and Northern Spy fruit sprayed for five and seven years, respectively, with flotation and lime-sulphur amounted to 95 and 97 per cent., respectively, of the crops, the slight difference in favour of lime-sulphur mainly resulting from the poorer control afforded by the flotation product (10 per cent.

diseased fruit) in one season of very severe infection. The average reduction caused by foliar injury in the yield of lime-sulphur-sprayed McIntosh trees over a three-year period was more than a box per tree as compared with flotation sulphur, a difference of 20 per cent. In a five-year test McIntosh flotation sulphur-sprayed trees yielded more than an additional box of fruit, an increase of 17 per cent. over those treated with lime-sulphur, while Northern Spy trees receiving flotation sulphur over a seven-year period outyielded those to which lime-sulphur was applied by three boxes per annum or 40 per cent. Some of the newer types of mild sulphur with small particles are superior to flotation and almost equal to lime-sulphur for scab control, even in bad seasons, but the coarse wettable brands are less satisfactory, the percentage of clean fruit from trees treated with them falling as low as 60 per cent. in some years.

Savage (E. F.) & Cowart (F. F.). **Factors affecting Peach tree longevity in Georgia.**—*Bull. Ga Exp. Sta.* 219, 15 pp., 7 figs., 1942.

Winter injury, in its two forms of crown damage and sunscald or south-west injury, is the major factor in the heavy losses in the peach orchards of Georgia. The former, predominant in the southern part of the State, results from immaturity of tissues occasioned by late or partially resumed growth preceding sub-freezing temperatures, whilst the latter is generally attributed to high temperature during sunny days in winter followed by sudden frosts at night. In north Georgia erosion is a factor operating to bring about the death of winter-injured trees. Rootstocks not resistant to cold injury are liable to another type of winter injury. Strong winds in the autumn may rock the tree and cause the formation of a pocket round the tree into which the cold air penetrates causing death. Other factors of less importance are crown gall [*Bacterium tumefaciens*] and phony disease [*R.A.M.*, xvii, p. 125], trees affected by either of which should be promptly destroyed. During the period 1938 to 1940 inclusive 68 (0·008 per cent.), 39,860 (0·38 per cent.), and 134,168 (1·74 per cent.) trees infected with phony disease were found in north, central, and south Georgia, respectively. Prolonged dormancy or delayed foliation due to insufficient hours of cold below 45° F. is a factor in longevity in some varieties.

Roberts (J. W.). **The ascogenous stage of the Peach constriction-disease pathogen.**—*Phytopathology*, xxxii, 4, pp. 335–336, 1 fig., 1942.

A culture of the species of *Phomopsis* causing constriction disease of peach [*R.A.M.*, xx, p. 310] was obtained from Delaware and transferred to oatmeal agar on 4th December, 1940, a sterilized fragment of peach twig being added five days later. After a month typical pycnidia developed both on the agar and the twig and in September, 1941, subspherical perithecia, typical of *Diaporthe*, were found on the two substrata. The paraphysate asci were clavate, with a refractive ring in the apical wall, 49 to 57 by 8 to 10 μ, and contained uniseptate, 4-guttate, biseriate ascospores, 12 to 13 by 4 μ. On the basis of these characters the fungus is tentatively referred to *D. perniciosa*.

Bodine (E. W.) & Newton (J. H.). **The rasp leaf of Cherry.**—*Phytopathology*, xxxii, 4, pp. 333–335, 1 fig., 1942.

In 1935 Royal Ann cherry trees in Delta County, Colorado, were observed to be affected by foliar abnormalities which subsequently spread, though in a milder form, to the Bing and Lambert varieties, extension of the disorder in the Paonia district being rapid in 1940–1. The most prominent symptom is the enations, ranging from elongated protuberances to raised, serrate, leaf-like growths on the under sides of the foliage, which usually radiate outwards from the midrib towards the margins and are mostly furnished with apical glands. The upper leaf surface bears sunken rugosities of an abnormally pale colour, exactly corresponding to the dorsal outgrowths, the likeness of which to the teeth of a coarse rasp suggested the designation of the trouble.

Severely affected leaves are small, narrow, and malformed, the lamina frequently tending to fold upon itself ventrally. Bud-inoculation tests point to a virus with a two-year incubation period as the agent of the disease.

King (Mary E.) & Harris (R. V.). **Studies in Strawberry virus diseases. IV. Symptom expression of yellow-edge in the variety Royal Sovereign.**—*J. Pomol.*, xix, 3 & 4, pp. 212–226, 4 graphs, 1942.

After reviewing earlier observations made at East Malling on yellow edge of the Royal Sovereign strawberry [*R.A.M.*, xx, pp. 72, 586], the authors give a full account of their further studies on the subject. As a general rule affected plants gradually deteriorate, the symptoms becoming more marked as the plants age. However, not all plants that show mild to moderate yellow edge in their maiden year develop more severe symptoms later. Some appear to be affected with a mild form which does not become progressively worse. Hence, symptom intensity among the individuals of a set of diseased plants may vary at any one time. That these variations are not due to differences in nutrition was demonstrated. It was observed that wild strawberries (*Fragaria vesca*) were never found to be naturally infected when growing in woods, but in the greenhouse and in experimental plots readily became infected by grafting or by attack by viruliferous strawberry aphids [*Capitophorus fragariae*]. Wild and Royal Sovereign strawberries planted out in a cleared, cultivated patch of woodland were discovered by aphids and most of the plants became infected, while in other ground in the vicinity, where the natural vegetation had otherwise not been disturbed, wild strawberries and Royal Sovereign were not found by aphids, and remained healthy. The natural freedom from attack of *F. vesca* would, therefore, seem to be related to the behaviour of the strawberry aphid, rather than to a nutritional difference between cultivated loam and virgin woodland soil. When healthy and infected wild and Royal Sovereign plants were grown in pots containing (1) good greenhouse compost, (2) woodland soil, and (3) peat, no differences in symptom expression resulted as between the different soils, there being much greater variation in any one soil than between plants in different soils.

The possibility that two or more strains of the virus differing in virulence might be involved was investigated. Two clones of Royal Sovereign, mildly and severely affected [ibid., xxi, p. 3], respectively, were used along with healthy plants of the Malling 35 clone. Mildly and severely affected plants were grafted together in pairs by stolon inarching, while healthy plants were also grafted to each infector. Controls were set up in which two mild infectors were grafted together, with a healthy plant grafted to each. The results obtained did not support the view that a protective action is exercised by mildly affected plants against infection from severely affected ones, but they did show that the two different types of symptoms behave in a constant fashion. Other clones, however, from mildly affected parents contained some plants that developed severe symptoms and some clones from severely infected parents gave mildly affected plants. It seems possible, therefore, that if different strains of virus are present, they are present as a mixture, except for the consistently mild clone, which may be pure.

Two seasons' observations in the field on plants of clone Malling 35 free from yellow edge but affected with mild crinkle (set *a*), plants showing mild yellow edge (*b*), and severe yellow edge (*c*) planted out in randomized blocks showed that on the whole plants of sets *a* and *b* classified as mild in 1938 were still mild in 1939, though some had become severely affected. The plants severely affected in the first year mostly remained so in the second. Again no apparent resistance was shown by mildly infected plants, as compared with healthy ones, towards infection with more severe strains. Apparently, once a plant shows typical symptoms, either mild or severe, in one season, it tends to keep them in the following year; they may become one stage worse, but they remain in the same category.

The immediate result of infection is flattening of the plant, followed later by dwarfing; both processes become progressively more marked as the symptom expression intensifies. Affected plants also show a considerably reduced runner production.

In Royal Sovereign strawberries high susceptibility is combined with well-marked symptom expression. The symptoms are, however, sometimes masked, this characteristic being related to the interaction of three factors, (*a*) seasonal weather conditions, (*b*) soil conditions, especially soil moisture, and (*c*) the age of the infected plants. Some infected plants generally develop symptoms in early summer; a period follows when the symptoms decrease, after which they become more conspicuous again in autumn. This fluctuation is related to temperature and soil moisture conditions, symptom expression being encouraged by damp weather, and inhibited or reduced by hot, dry weather. A preliminary roguing of established runner beds should be effected in June, and the final inspection and roguing made in September and October. New plantings of runners should be similarly inspected and rogued. Under uniform seasonal conditions maiden plants that become infected are less likely to show symptoms than comparable two-year-old plants, so that roguing will probably prove more effective on two-year-old runner beds than on maiden ones.

Harris (R. V.) & King (Mary E.). **Studies on Strawberry virus diseases. V. The use of Fragaria vesca L. as an indicator of yellow-edge and crinkle.**—*J. Pomol.*, xix, 3 & 4, pp. 227–242, 2 pl., 1942.

Experiments are described in which strawberry plants of different varieties under trial at East Malling were tested for the presence of yellow edge and crinkle [see preceding abstract] by grafting to possible indicator plants, chiefly the wild *Fragaria vesca* [*R.A.M.*, xvi, p. 761].

The results obtained have in part been reported from other sources but the following points may be mentioned. Crinkle symptoms in *F. vesca* vary in intensity [ibid., xviii, p. 464], but include different types, one of which usually predominates. The two most prominent types are a dark green puckering of the leaf laminae, frequently with slight thickening in the darker green, raised areas, and light yellow-green chlorotic spots which develop irregularly. Some twisting and curling of the laminae may develop, or these parts may remain flat and dwarfed and turn very red near the veins. The more severe the attack, the more dwarfed the whole plant becomes, whatever the dominant symptom type.

The symptoms of yellow edge in *F. vesca* are less simple to classify, and occasionally it was difficult to distinguish between plants showing crinkle alone and those infected with both viruses. *F. vesca* indicator plants grafted to a plant affected with yellow edge and crinkle were grouped into three stages. In stage 1, developed after three to four weeks, the leaves are not reduced in size, but the midrib of each leaflet is curled backwards and downwards, so that the whole leaf has a rounded outline when seen from the side, as opposed to its normal, flat appearance. Such leaves generally show prominent, dark green, raised-up areas. Sometimes chlorotic speckling is also present, this probably being due to the crinkle virus. The leaf curling is the distinct feature due to the yellow-edge virus, and has not been seen on plants affected by crinkle alone. On each *F. vesca* indicator one to three leaves may develop symptoms of this stage; these symptoms persist as long as the leaf remains, and do not develop further.

In stage 2, the leaves are not curled but are one-half or one-quarter the normal size. They are asymmetrical, and the leaflets are sometimes arranged asymmetrically on the petiole. The usual symptoms of local laminal bulging (puckering), chlorotic spotting, and reddening may also be present. Such leaves may be more numerous than all other types of leaf.

Stage 3, which is the final one, is not always reached. In this the leaves are extremely minute and the laminae greatly reduced or wanting. Sometimes these leaves do not even show typical crinkle symptoms but are just very small, smooth, green

leaves, reddened in the region of the veins. In some cases, if most of the leaves are in stage 3, the laminae of all the previously healthy leaves and of those in stage 1 may have fallen off, leaving the bare petioles; such plants often die early.

The viruses do not appear visibly to affect fully developed leaves, but only those developing at or after the time when infection takes place, and it is thought that leaves with stage 1 symptoms were already partially developed at the time of infection. At any stage bending and twisting of the tips of the young developing stolons may be present, and young runner plants produced by these stolons are severely affected, their leaves showing stage 2 or stage 3 symptoms.

In the course of experiments with diseased plants of the American varieties, Premier, Fairfax, and Dorsett, some, when grafted to *F. vesca* indicators, induced symptoms of a new kind. In the indicator plants all the leaves were curled and dwarfed, and not puckered or chlorotic-spotted, but yellowish-green. The entire plant developed a matted, tussocky appearance. It is thought that this condition may be due to yellow-edge virus being present alone.

Certain selections of the susceptible varieties Royal Sovereign, Sir Joseph Paxton, and King George induced no visible reaction in *F. vesca*, and were therefore considered to be virus-free. Selections of certain varieties that showed no symptoms transmitted disease when grafted to *F. vesca*; nearly all the selections of such carrier varieties induced symptoms in *F. vesca*, but one strain of Huxley's Giant appeared to be free from any virus, and is being propagated for further trials.

During this work ample evidence was obtained which demonstrated that strawberry species and varieties differ markedly in their resistance to, or tolerance of, these viruses. No hard-and-fast line can be drawn between tolerant and susceptible varieties, which constitute a graded series from very susceptible intolerants to varieties carrying the virus without showing any symptoms.

LEACH (R.). **Banana leaf spot. When to spray and why.**—[*Pamphl.*] *Leaf Spot Control Div. Dep. Agric. Jamaica*, 5 pp., 8 diags., 1942.

This popular account of banana leaf spot (*Cercospora musae*) emphasizes some important features in the life-history of the causal organism in relation to the work of control in Jamaica [*R.A.M.*, xxi, p. 242]. The bulk of infection, both from conidia and ascospores, occurs on the under leaf surfaces during or just after unfurling. The ascospores are expelled from the perithecia, generally in the still atmosphere of the early morning, and are borne upwards by light air currents, which sometimes convey them to plants higher up on the slopes of steeply inclined sites, but under windy conditions the dispersal of the spores is so widespread as to admit of heavy infection only between closely adjacent plants. The conidia produce foliar spotting, mainly linear, throughout the year; they may be dislodged from the lesions by leaf friction and carried away by the wind, but the ordinary mode of dissemination is by splashes of rain or dew. The lines formed by the conidial infections are mostly parallel to the edge on the left side of the leaf (viewed from the stem) and extend diagonally across it on the right. The ascospores produce apical spotting, principally between August and February, this feature of the disease being most conspicuous on tall plants and the conidial lines on shorter ones. Foliar scorching follows the production either of a large number of densely aggregated spots or the separation of part of the leaf from the main vein by a line of lesions. The leaves of rapidly developing young plants do not usually show heavy spotting until they have been five to six weeks in the open, while in older or slower growing ones the period of quiescence may be prolonged up to two months. This delay in the appearance of the symptoms is a noteworthy feature of leaf spot, indicating as it does that an access of infection is only observed six to eight weeks after its actual occurrence.

Sprays check the disease by (1) preventing or lowering the production of conidia and by rendering the dew poisonous to those coming in contact with it before they are

detached from the leaf, and (2) killing the conidia and ascospores that have settled on but not infected the leaf or may subsequently settle on the sprayed leaf. The results of experiments have shown that normal spraying is very effective in controlling the disease except in the ascospore season (August to February). If the disease is well under control by the end of August, comparatively little spraying may be required between then and the following March, whereas if the disease is not controlled by the end of August normal spraying is unable to control ascospore infection effectually up to the end of January. In order to prevent the production of ascospores it is important to remove all trash from the plants by August and bury it. Further removals should be made when required until the end of December. On the basis of these results spraying is recommended as follows. First intensive spraying (at the rate of 90 gals. per acre except where otherwise stated) on 2nd and 23rd March, 6th April, 27th April (3 leaf; 50 gals.); second intensive spraying on 15th June, 6th and 20th July, 3rd and 24th August, 14th September, and 5th October (the last three at 50 gals. per acre); and precautionary spraying on 7th December and 11th January. This represents 13 sprayings per annum but a further reduction to 10 sprayings may be sufficient in the following year.

PARRIS (G. K.). **Phytophthora parasitica on Papaya (Carica papaya) in Hawaii.**—*Phytopathology*, xxxii, 4, pp. 314–320, 3 figs., 1942.

Some of the information in this account of the fruit and stem rot of papaws in Hawaii caused by *Phytophthora parasitica* has already been presented from another source [*R.A.M.*, xxi, p. 150]. Inoculation experiments with pure cultures of the fungus gave positive results on the stems, fruits, roots, and leaves of both wounded and unwounded plants, infection of the latter being promoted by maintenance in a humid atmosphere: the pathogen was recovered from a number of lesions thus induced.

YARWOOD (C. E.). **Stimulatory and toxic effects of copper sprays on powdery mildews.**—*Amer. J. Bot.*, xxix, 2, pp. 132–135, 1942.

After stating that he has secured control of several powdery mildews [*Erysiphe* spp.: cf. *R.A.M.*, xviii, p. 465] with copper and sulphur fungicides used as eradicant or protective treatments (unpublished data), and pointing out that copper fungicides are particularly useful against these diseases on sulphur-sensitive crops such as cucurbits, the author describes experiments in which bean plants were inoculated with a strain of *E. polygoni* from clover (*Trifolium pratense*) and another from bean (*Phaseolus vulgaris*), and then treated with copper sprays and dust. Both the treatments and the inoculations were carried out when the primary leaves were about two-thirds of full size.

The results obtained were as follows. The conidia of clover powdery mildew dusted on the surface of 7 c.c. of test solutions in Syracuse watch glasses and held for 10 hours in diffuse daylight gave the following germination values (average of five tests): water, 42 per cent.; 0·1 per cent. copper sulphate, 46 per cent.; 1 per cent. copper sulphate, 31 per cent.; 0·1 per cent. mercuric chloride, 31 per cent.; and 1 per cent. mercuric chloride, 4 per cent.

On glass slides the dried deposit from 0·1 per cent. Bordeaux mixture + 0·1 per cent. cottonseed oil was highly toxic when water was added to the slides along with the conidia of the clover powdery mildew and the slides were inoculated at 100 per cent. relative humidity. The same deposit was, however, highly stimulatory when the dry slides with dry spores were incubated at 90 per cent. relative humidity. Intermediate results were obtained at 100 per cent. relative humidity, in the absence of free moisture. The bean mildew gave analogous results. Similar dosages of Bordeaux mixture

without cottonseed oil were only slightly, if at all, stimulatory, and similar dosages of copper in the form of cuprocide dust were toxic in all environments. All three forms of copper were toxic in all environments to barley powdery mildew (*E. graminis*).

Copper sulphate and Bordeaux mixture at various dosages were suspended in 2 per cent. sucrose agar, and the poured plates dusted with bean powdery mildew conidia. In one typical test the percentage germination on sucrose agar containing 0·06 per cent. Bordeaux mixture was 71 per cent., as against 50 per cent. in the controls, and the average lengths of the germ-tube were 63 and 58 μ, respectively.

When light was sufficiently strong to inhibit mildew development after inoculation, bean plants sprayed with 0·1 per cent. Bordeaux mixture often showed more mildew than unsprayed plants. Bordeaux mixture was more effective as an eradicant than as a protective spray for bean mildew, no mildew stimulation being observed when Bordeaux mixture was used as an eradicant spray.

These results emphasize the importance of experimental conditions in the study of fungicides, since it shows that a given dose of copper may be toxic, neutral, or stimulatory to the powdery mildews studied, according to the environment and other conditions of the test.

ROBERTS (J. W.). **Substitutes for copper and zinc in fungicidal sprays.**—*Industr. Engng Chem.*, xxxiv, 4, pp. 497–498, 1942.

Of recent years the writer and his colleagues at the Bureau of Plant Industry, United States Department of Agriculture, Beltsville, Maryland, have tested several hundred organic materials with a view to their potential fungicidal uses, and the results obtained are of interest in view of the threatened shortage of copper and zinc for fungicidal sprays. One of the most promising is phenothiazine, which has given fair control of apple scab [*Venturia inaequalis*], shown some degree of efficacy against bitter rot [*Glomerella cingulata*], and been effective in mild cases of cherry leaf spot [*Coccomyces hiemalis*]. Its principal weakness (apart from present scarcity and prohibitive cost) is lack of adherence, which has lately been much improved by finer grinding. Dinitro compounds may also form the basis of successful fungicides, the water-soluble sodium salt of dinitro-ortho-cresol [elgetol], for instance, being destructive to fungi in fallen leaves [e.g., *V. inaequalis* on apple foliage: *R.A.M.*, xxi, p. 245]. The thiuram disulphides [see next abstract] merit further investigation as orchard fungicides: tetramethylthiuram disulphide, recently reported as effective against turf pathogens [*Corticium solani* and *Sclerotinia homoeocarpi*: ibid., xx, p. 367], has likewise proved toxic to fungus spores in the author's tests, but causes injury to apple, peach, and cherry leaves and fruit in combination with lime or lead arsenate. Mention should further be made of the thiocarbamates, one advantage of ferric dimethyl dithiocarbamate [see next abstract] over all the other substances tested being its satisfactory spreading and adhesive properties.

TISDALE (W. H.) & FLENNER (A. L.). **Derivatives of dithiocarbamic acid as pesticides.**—*Industr. Engng Chem.*, xxxiv, 4, pp. 501–502, 1942.

Investigations by the du Pont Company since 1931 have revealed a marked degree of specificity in relation to different kinds of pests among members of the dithiocarbamic acid group of organic sulphur compounds [see preceding abstract], while their fungicidal efficiency was reduced by the replacement of one or both alkyl groups by those of aryl. In laboratory tests sodium dimethyl dithiocarbamate was lethal to the spores of barley covered smut (*Ustilago hordei*) at a dilution of 1 part to 30,000 of water, twice the concentration being necessary to produce comparable results with tetramethylthiuram monosulphide, which was also effective at a strength of 0·8 per cent. in alcohol solution against *Trichophyton* and other skin infections; similar results were obtained in the therapy of dermatomycoses with tetraethylthiuram

monosulphide and sodium dimethyl dithiocarbamate. Tetramethylthiuram disulphide has been reported to be highly effective against tulip 'fire' (*Botrytis tulipae*) in Europe, while good results have also been secured in tests on apple scab [*Venturia inaequalis*]. Limited experiments with tetraethylthiuram monosulphide (0·2 per cent.) were successful in combating rose mildew [*Sphaerotheca pannosa*]. Cherry leaf spot [*Coccomyces hiemalis*] and brown rot of stone fruits [*Sclerotinia fructicola* and *S. laxa*] yield to treatment with ferric dimethyl dithiocarbamate [*R.A.M.*, xxi, p. 296], which has also given promising indications as a remedy for apple scab at the rate of 1 to 1½ lb. per 100 gals. solution. This extremely finely divided product adheres exceptionally well to foliage and fruit without adjuvants.

JANKE (F.). **Die mikrobielle und fungizide Wirkung des Kalkstickstoffs.** [The microbial and fungicidal action of calcium cyanamide.]—*Zuckerrübenbau*, xxiv, 3, pp. 29–40, 3 figs., 1942.

The writer summarizes investigations conducted (mostly in Germany) into the beneficial effects of soil treatments with calcium cyanamide on the health of crops suffering from various well-known diseases, and the stimulatory action of the compound on the more desirable bacterial members of the soil microflora, as opposed to moulds and fungal pathogens.

WESTON (W. H.). **A Petri dish holder for mechanical stages.**—*Science*, N.S., xcv, 2468, pp. 415–416, 2 figs., 1942.

The Petri dish holder described in this paper consists essentially of a spring steel clip fixed to a frame which fits into a slide-holder of the mechanical stage. The frame, made of sheet brass, has a horizontal base, 3 by 1 in., with one side cut away to accommodate the dish, and is provided with three bent-up ears to which the clip, of suitable length and curvature tightly to encircle the dish, is soldered. This holder may be conveniently modified for special purposes. Thus, the frame might be screwed to a brass strip that fits into the stage slot in place of the usual slide-holding fingers, or the clip might be attached, as in a model independently devised by Dr. E. Runyon of Agnes Scott College, to a small bakelite block screwed to one of the slide-holding fingers of the mechanical stage, while for holding the uncovered plate upside down to avoid contamination a holder that supports the plate at a height of about 1 in. is described.

CASH (MARY). **A simple method for determining the growth rates of fungal colonies at different hydrogen ion concentrations.**—*Aust. J. Sci.*, iv, 4, pp. 135–136, 1942.

The following technique was devised at the University of Sydney to eliminate as far as possible the effect of staling substances on the growth of fungal mycelia in nutrient media. A single spore of the fungus is inoculated on the centre of a disk of moistened plaster of Paris poured into a circular mould 55 mm. in diameter and 6 mm. in depth, and growth is measured as the average diameter of five colonies. To facilitate these calculations two diameters of the disks at right angles are marked in mm., and the entire surface marked in mm. squares with a lead pencil, the disks then being placed in Petri dishes and autoclaved. A prepared buffer solution is poured into a sterilized Petri dish to just beneath the upper surface of the disk, care being taken to avoid flooding. The method was successfully used for the determination of the effects of the hydrogen-ion concentration on the growth rate of *Gloeosporium album* and *Penicillium expansum* at 20° C. in potato dextrose solution buffered by disodium phosphate and citric acid (P_H 2·6 to 4·0). To obviate any possibility of nutrient starvation the disks were daily transferred to Petri dishes containing the requisite amount of fresh medium.